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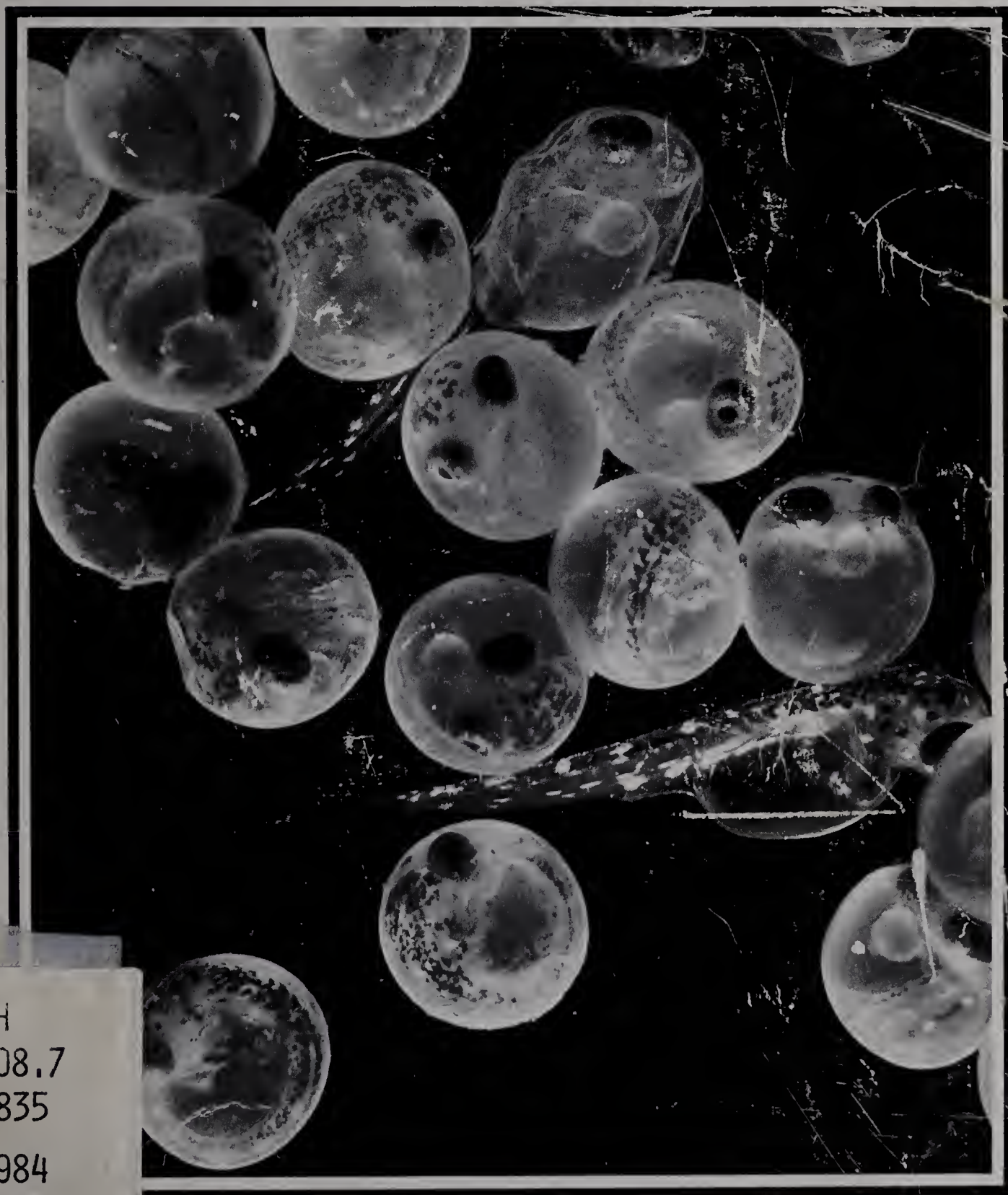


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Addison-Wesley

Biology

Tests



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Tests for
Addison-Wesley

Biology

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By Pamela Ramsey



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FOREWORD

This test program is designed to evaluate students' comprehension of the objectives set forth for each chapter of the Addison-Wesley BIOLOGY text. A section that follows titled "Test Questions and Chapter Objectives" correlates specific test questions with the chapter objectives they concern. This feature will enable you to tailor a test to the material you have actually covered in a particular chapter.

Two semester tests, each covering half of the text, follow the chapter tests. Semester Test 1 reviews chapters 1 through 14, Semester Test 2, chapters 15 through 26. A separate answer key lists answers to all the objective questions, by test. In addition, essay questions that may be used to supplement the chapter and semester tests are presented at the end of this book. Each essay question is followed by a suggested answer.

The chapter tests, all three pages long, are designed to be completed within a standard 50 minute class period. For semester tests, add another half hour to 45 minutes to the total test time; each semester test is six pages. Each test covers a range of difficulty, from the easier recall and vocabulary questions to questions that require some analytical or interpretive skills. The ratio for each test is roughly 10 percent easy, 70 percent average, and 20 percent difficult questions.

The pages of the test program are perforated and three-hole punched for easy removal and storage in the *Teacher's Resource Book* binder. The tests are designed as blackline masters for reproduction on any copy machine. Every test page is identified at the top as part of a chapter test of the Addison-Wesley BIOLOGY program. Blanks for student's name, class, and date are also included at the head of each test page.

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Test Questions and Chapter Objectives

Chapter Tests, 1–26

Semester Test 1

Semester Test 2

Answer Key

Optional Essay Questions

Test Questions and Chapter Objectives

Test questions that correlate with each chapter objective follow in parentheses.

Chapter 1

1. Explain what biology is and give examples of areas of biological study. (11, 14)
2. Explain the meaning of the words *organism* and *species* and show the relationship between an organism and its species. (3, 6, 19)
3. Show that, though diverse, organisms can be classified on the basis of similarities. (13, 19)
4. Describe the cell as the basic unit of life. (1)
5. Relate structure and function in cells. (29)
6. Describe the organization of multicellular organisms. (13, 20, 21)
7. Describe the three basic life functions of all living things: obtaining and using food, controlling life processes, and responding to the environment. (22)
8. Show that reproduction is necessary for species survival. (22)
9. Explain and give examples of the concepts of food chains and food webs. (2)
10. Describe ecosystems in terms of their producers, consumers, and decomposers. (12, 26)
11. Illustrate interactions in the ecosystem with examples of symbiosis and cycling of chemicals. (7, 8, 10, 27)
12. Describe and give examples of adaptations. (28)
13. Show how variation, adaptation, and survival can play a role in changing a species over time. (30)

Chapter 2

1. Explain the need for classification as a tool for organizing and naming organisms. (1, 8)
2. Explain and give examples of binomial nomenclature. (3, 18)
3. Describe the categories of biological classification. (5)
4. Explain relatedness as a basis for classification. (16, 17)
5. Describe methods used by taxonomists to determine relatedness. (19, 20)
6. Name and describe the basic organization of the five kingdoms. (11, 12, 21, 22, 23, 24)
7. Give examples of characteristic organisms in each kingdom, as well as in the main plant and animal phyla. (11, 12, 21, 22, 23, 24, 26, 27)
8. Name and classify the representative organisms studied throughout the book. (15, 22, 26, 28)

Chapter 3

1. Describe the simple microscope as developed by van Leeuwenhoek. (16, 18)
2. Describe the compound microscope as developed by Hooke. (16, 18)

Chapter 3 (continued)

3. Explain how an electron microscope works and contrast it with the light microscope. (12, 17)
4. Describe the scale used for measuring cells. (20)
5. Differentiate between hypothesis and theory. (21)
6. State the three parts of the cell theory as it is known today. (22)
7. Describe the function and steps of the scientific method. (13, 23, 24)
8. Explain and give examples of specialization and division of labor in multicellular organisms. (25)
9. State the names and main functions of organelles found in cells. (1-10)
10. Compare and contrast the organelles found in cells of members of the five kingdoms. (15, 27)

Chapter 4

1. Diagram or describe the basic structure of matter in terms of elements, atoms, ions, molecules, and compounds. (2, 4, 6, 9, 11, 16, 17, 19)
2. Using a simple model of an atom, describe its structure. (11, 17, 18)
3. Differentiate between organic and inorganic molecules. (13)
4. Explain covalent and ionic bonding. (5, 14, 20)
5. Explain what occurs during a chemical reaction. (1, 21)
6. Describe the use of chemical equations to illustrate chemical reactions. (32)
7. Describe the methods by which organelles and molecules are isolated for identification. (10, 25)
8. List the kinds of compounds found in cells. (13, 26)
9. Describe the structure and functions of carbohydrates, lipids, proteins, and nucleic acids. (22, 23, 24, 26)
10. Describe various types of energy. Explain the conservation of energy and the concept that energy changes form. (27, 28, 29)
11. Describe the type of energy used by cells and show two energy changes that occur within cells. (7, 26)
12. Describe the structure, function, and mode of action of enzymes and explain why they are essential for living organisms. (3, 8, 30)
13. Using typical graphs and verbally, describe the effects of temperature and pH on enzyme action. (30)
14. Describe two types of enzymatic reactions: dehydration synthesis and hydrolysis. (31)

Chapter 5

1. Establish photosynthesis as the vital process that produces food and releases oxygen. (2, 11)
2. Describe Helmont's experiment and briefly summarize the historical development of our understanding of photosynthesis. (12)
3. Explain the summarizing equation for photosynthesis. (16, 17)
4. Describe the structure and functions of a leaf. Show how various parts of the leaf are adapted for their functions. (3, 7, 18, 19, 20, 21)
5. Describe the structure and functions of a chloroplast's grana and stroma. (23)
6. Name the pigments found in plants and explain their role in the absorption of light. (5, 22)
7. Describe the main events of the light and dark reactions of photosynthesis. (8, 25)
8. Explain how organic nutrients are synthesized from glucose and soil minerals. (26)
9. Explain the difference between essential and nonessential nutrients. (14)
10. Name and describe the main nutrients in food. (26, 27, 28)
11. Show how the amount of energy in food is measured. Relate the amount of energy found in food to energy use by the body. (30, 31)
12. Describe a healthful diet. (29)

Chapter 6

1. Establish cellular respiration as the process during which food is broken down, releasing energy that is used to make ATP. (2, 13, 15, 16, 21)
2. Explain the summarizing equation for cellular respiration. (18)
3. Describe ATP's synthesis and its role in cells. (13, 15, 16, 18, 25)
4. Describe the balance between respiration and photosynthesis. (22)
5. Explain the main steps in glycolysis, where it occurs, and the products of the process. (20, 23)
6. Briefly describe the main steps of the citric acid cycle, where it occurs, and the products of the process. (14, 20)
7. Describe the main steps of electron transport, where it occurs, and the products of the process. (23)
8. Explain the role of oxygen during electron transport. (14, 24)
9. Describe fermentation in yeast and vertebrate muscles. (9, 12)
10. Compare complete cellular respiration and fermentation. (21)
11. Explain how different nutrients are used by cells for energy. (26, 27)
12. Define *metabolic rate* and describe how it can be measured and compared in different species. (28, 29)
13. Relate an organism's metabolic rate to its body temperature and to its need for food. (28, 29, 30)
14. Explain the differences between warmblooded and coldblooded animals. (28, 29)

Chapter 7

1. Distinguish between cellular respiration, respiration, and breathing. (1, 2, 15)
2. Describe the principle behind the movement of gases in respiration. (2, 14, 21)
3. Summarize the four basic steps of respiration in aerobic organisms. (16)
4. Describe the structure and function of the respiratory systems of the representative organisms: bean, paramecium, hydra, earthworm, and grasshopper. (17, 21, 22, 23, 24)
5. Show how the four basic steps of respiration are accomplished in each of the representative organisms. (17, 21, 22, 23, 24)
6. Describe or diagram the human breathing mechanism. (25, 26, 27)
7. Describe the structure and function of the bronchial tree. (26, 27)
8. Describe respiration in the alveoli of the lungs, including the role of blood. (27, 28)
9. Explain homeostasis, using an illustration from the respiratory system. (9)
10. Describe how the rate of breathing is controlled. (10, 29, 30)

Chapter 8

1. Describe the five basic steps of getting and using food in all consumers and illustrate the steps with examples of various organisms. (1, 6, 16)
2. Explain the differences between mechanical and chemical digestion. (11)
3. Explain the difference between intracellular and extracellular digestion. (12)
4. Show how the five steps of getting and using food are accomplished in each of the representative organisms. (1, 6, 21, 22)
5. Explain the advantages of a digestive tract over a digestive cavity. (21)
6. Describe the parts of the human digestive tract and the glands associated with it. (23, 25, 31)
7. Describe chemical and mechanical digestion in the mouth, stomach, and small intestine. (24, 25, 28)
8. Describe nutrient absorption in the small intestine and the colon. (19, 27)
9. Describe egestion of food wastes from the body. (2, 22)
10. Explain and give examples of control of the human digestive system. (31)
11. Describe absorption by cells and give an example of how this process is controlled. (18, 26, 30)
12. Describe how cells use and store absorbed nutrients. (32)
13. Explain how regulation of food absorption and use in the human body is related to homeostasis. (32)

Chapter 9

1. Explain the functions of transport in all living things. (16)
2. Describe how molecules move by diffusion and osmosis. (17, 18)
3. Distinguish between and give examples of passive transport and active transport. (19, 20)

Chapter 9 (continued)

4. Explain how transport by endocytosis and exocytosis occurs. (10)
5. Outline the three main features of transport systems. (16)
6. Describe transport in the bean, paramecium, hydra, earthworm, and grasshopper. (20, 24, 25)
7. Explain the rise of water in a plant stem. (22)
8. Contrast open and closed systems of transport. (6)
9. Describe the structure and function of the human transport system, including the blood, blood vessels, and heart. (1, 3, 7, 12, 27, 30, 31, 32)
10. Discuss how the human transport system is regulated. (28)
11. Briefly describe what happens in heart attack, arteriosclerosis, and hypertension. (2)
12. Relate the functions of the lymph system to the transport system. (14, 26)
13. Explain the relationship between transport and homeostasis. (11)

Chapter 10

1. Explain what excretion accomplishes and how it relates to homeostasis. (2, 16)
2. Describe the cellular activities that produce nitrogenous wastes and carbon dioxide. (5, 17, 13)
3. Describe the three kinds of nitrogenous wastes and how the nitrogenous waste an organism produces is related to the environment in which the organism lives. (1, 5, 11, 12, 14, 19)
4. Explain the significance of salt and water balance. (16, 18)
5. Describe the four main steps of excretion. (20)
6. Describe excretion in the bean, paramecium, hydra, earthworm, and grasshopper. (6, 7, 8, 11, 13, 14, 15, 22, 25)
7. List the four organs of excretion in the human body. (9, 24)
8. Describe how the lungs function in removing carbon dioxide. (24)
9. Explain how the skin eliminates salts and excess body heat. (9)
10. Describe the functions of the liver. (24, 26)
11. Name and give the function of the main parts of the urinary system. (27, 28, 29, 31)
12. Describe the structure and function of the nephron. (29-32)
13. Explain how ADH regulates kidney function. (28)

Chapter 11

1. State the functions and give examples of locomotion, movement of body parts, and movement of cell parts. (4, 17)
2. Give examples of how movement aids organisms in interacting with other organisms. (16)
3. Describe and give examples of how cells move by cilia, flagella, and pseudopods. (3, 17)
4. Describe the two methods of movement in plants. (18)

Chapter 11 (continued)

5. Compare movement in animals with and without skeletons. (20, 21, 22)
6. Compare exoskeletons with endoskeletons. (13, 20)
7. Describe movement and locomotion in the bean, paramecium, hydra, earthworm, and grasshopper. (9, 21, 22, 23)
8. State what the two main parts of the human skeleton are, and relate the shape of bones to their function. (14)
9. Describe the structure and function of cartilage, bone, ligaments, and tendons. (2, 8, 10, 24)
10. Describe the three types of muscle. State the function and location of each in the body. (15, 25, 26, 27, 29)
11. Explain the sliding filament theory of muscle action. (28)
12. Explain what happens to muscle during exercise, sustained exercise, and lack of use. (11, 30)
13. State how each of the three types of muscle are controlled in the body. (15, 31)

Chapter 12

1. Explain the function of hormones in living things. (16)
2. State three steps in the delivery of a hormone to its target. (12, 16, 17)
3. Explain the action and give examples of a plant's growth hormones. (11, 18, 19)
4. Describe plant hormones for ripening, flowering, and natural defenses. (11, 18, 19)
5. Using examples, compare the action of protein and steroid hormones in animals. (21, 22)
6. Explain hormonal regulation by feedback. (23)
7. Explain hormonal control of insect development. (24, 25, 26)
8. Compare complete and incomplete metamorphosis and give examples of each. (25)
9. Name the major glands in the human endocrine system. Include the names and main functions of the hormones they produce. (1-10, 28, 30)
10. Explain how thyroid production is controlled. (14, 23)
11. Describe the menstrual cycle and explain how it is regulated by hormones. (1, 15, 28)

Chapter 13

1. Explain the relationship between stimulus, receptor, and effector. (11, 16)
2. Describe the basic structure and function of neurons and glial cells. (3, 12, 17)
3. Name the three types of neurons and state the function of each. (16, 18)
4. Explain what parts of neurons are found in the central nervous system, ganglia, and nerves. (4, 8, 15)
5. Diagram the chemical events of the nerve impulse. (7, 20, 21)
6. Explain the chemical events that occur at the synapse. (21, 22)
7. Explain the major differences between invertebrate and vertebrate nervous systems. (23, 24)
8. Describe nervous control in the hydra, earthworm, and grasshopper. (23, 24)

Chapter 13 (continued)

9. Diagram a reflex arc. (27)
10. Explain how nerves stimulate skeletal muscles to contract. (28)
11. Name, describe, and state the functions of the main parts of the human central nervous system. (15, 28, 30, 31, 32, 33)
12. Describe the location and function of each of the main parts of the brain. (29, 30, 31, 32)
13. Describe the structure and function of the peripheral nervous system. (28, 30, 33)
14. Explain and give an example of how the autonomic nervous system controls vital organs. (28, 33)
15. Name and briefly describe four disorders associated with impairment of nervous system tissue. (6, 25)

Chapter 14

1. Name the six main types of receptors found in animals, including the types of stimuli associated with each. (3, 5, 11, 17, 27, 33)
2. Give three examples of stimuli not detected by humans. (18)
3. Describe the basic action of all receptors. (19)
4. Explain how detection of a stimulus results in perception. (13, 21)
5. State ways in which perception aids survival of individuals and species. (2, 3, 24)
6. Describe echolocation in bats and hearing in moths and grasshoppers. (14)
7. Describe the structure and function of the human ear and explain how humans perceive sounds. (5, 10, 15, 22, 23, 24, 25)
8. Describe the structure and function of the semicircular canals and state the location of other proprioceptors. (17, 24)
9. Describe the structure and functions of skin receptors. (3, 11)
10. Compare light reception by cells, eyespots, and simple eyes. (26)
11. Explain the structure and function of the insect's compound eye. (6, 27)
12. Explain how the vertebrate eye is like a camera. (28)
13. Describe the structure and function of the human eye and explain how humans see black, white, color, and depth. (28, 29, 30, 31, 32)
14. Describe the cause of astigmatism, nearsightedness, and farsightedness, and state how these conditions affect sight. (9)
15. Describe the human chemoreceptors for smell and taste. (33)
16. Diagram the location on the human tongue of taste buds for the four major tastes. (20)

Chapter 15

1. Identify examples of reproduction at three levels: molecule, cell, and organism. (5, 10, 12)
2. Identify DNA as the carrier of heredity and the code for protein synthesis. (7, 9, 17, 30)
3. Describe DNA according to the Watson-Crick model. (14)
4. Explain the basic structure of DNA nucleotides. (11, 16, 18)

Chapter 15 (continued)

5. Explain the steps in DNA replication. (5, 11)
6. Describe what occurs during cell division. (12, 19)
7. Describe the phases of mitosis. (3, 4, 6, 23)
8. Compare animal and plant cytoplasmic division. (15)
9. Explain why cells have a prescribed life span. (8)
10. Contrast normal cell division with cancer. (13)
11. Describe the structure of RNA and contrast it with DNA. (27)
12. Explain the steps in protein synthesis. (1, 9, 17, 28, 29, 30)
13. Relate protein synthesis to cellular control, heredity, and structural development. (21)

Chapter 16

1. Compare sexual and asexual reproduction. (11, 16)
2. Define, describe, and give examples of the four types of asexual reproduction. (17, 18)
3. Define and give the characteristics of a clone. Explain natural and artificial cloning. (5, 20, 21)
4. Explain how the results of Gurdon's experiments on frog cloning support the idea that all body cells contain information about how to reproduce the species. (20)
5. Relate variations among species members to success of a species and discuss the relationship between variation and asexual and sexual reproduction. (16, 20, 21)
6. Explain the function of meiosis during sexual reproduction. (3, 26)
7. Describe the phases of meiosis. (13, 24, 25, 26)
8. Contrast isogametes and heterogametes. (15)
9. Explain the function and steps in gametogenesis. Compare spermatogenesis and oogenesis. (6, 7, 9, 14, 27, 28)
10. Explain the differences between internal and external fertilization. (29)
11. Explain what parthenogenesis is and how it occurs. (30)

Chapter 17

1. Explain the difference between natural and artificial vegetative propagation. Give examples of each. (8, 9, 16, 17)
2. State the advantages and disadvantages of vegetative propagation. (26)
3. Diagram a generalized plant life cycle showing alternation of generations. (3, 20)
4. Describe the life cycle of mosses. (21, 22)
5. Describe the life cycle of ferns. (22, 23)
6. Describe the features that adapt seed plants to land. (28)
7. Describe the life cycle of seed plants. (20, 23, 30)
8. Describe flower structure, function, and types. (1, 2, 6, 7, 11, 24)
9. Explain how fertilization occurs in flowering plants. (25)

Chapter 17 (continued)

10. Compare self- and cross-pollination. Explain the advantages of cross-pollination and adaptations that prevent self-pollination. (27)
11. Show how flowers are adapted for wind pollination and animal pollination. (2)
12. Describe seed and fruit formation. (5, 6, 16, 25)
13. Show how seeds are adapted for dispersal. (28)
14. Describe seed germination, including the conditions necessary for germination. (29)
15. Describe primary and secondary plant growth. (10, 13, 15, 31, 32, 33)
16. Describe the life span of seed plants in terms of annuals, biennials, and perennials. (14)

Chapter 18

1. Describe the basic steps in vertebrate reproduction. (2, 17, 18)
2. Describe the human male and female reproductive systems and production of gametes. (4, 5, 7, 8, 11, 17, 18)
3. Describe fertilization in humans. (20)
4. Describe cleavage and the early stages of embryo development. Identify the three germ layers and indicate what tissues they will become. (2, 6, 13, 21, 22)
5. Describe the structure and function of the placenta and the embryonic membranes in human reproduction. (9, 10, 23, 25, 26, 33)
6. Explain and give an example of embryonic induction. (6)
7. Describe the primitive streak. (24)
8. Briefly describe the events of the trimesters of pregnancy. (14, 27, 29)
9. Explain the steps of the birth process. (1, 30)
10. Describe how identical and fraternal twins are formed. (15)
11. Discuss human growth after birth. Explain how sensory adaptations bring males and females together for reproduction. (3, 16, 29)
12. Describe how courtship behaviors and special mating periods help synchronize gamete release in males and females. (19)
13. Describe the four patterns of reproduction and development found in vertebrates. (32)
14. Explain how large numbers of offspring and parental care are adaptations for survival. (32)

Chapter 19

1. Describe the techniques used by Mendel in his experiments on garden peas. (13)
2. Explain the Law of Dominance and relate it to the gene concept. (19, 23, 29)
3. Explain the Law of Segregation and relate it to meiosis and fertilization. (18)
4. Explain the Law of Independent Assortment and relate it to chromosomes and genes. (19)
5. State the law of chance for the probability of two independent events occurring at the same time. Show how Mendel's Law of Segregation is based on this law. (4, 18, 30)
6. Use a Punnett square to analyze genetics problems. (28)

Chapter 19 (continued)

7. Use Mendel's laws to predict the probability of genotypic and phenotypic outcomes in crosses involving one trait. (23, 25, 27)
8. Use Mendel's laws and a Punnett square to predict the genotypic and phenotypic probability in a dihybrid cross. (30)
9. Explain why incomplete dominance is an exception to the Law of Dominance and linkage is an exception to the Law of Independent Assortment. (19, 22, 29)
10. Explain how genetic counselors make practical applications of the Laws of Heredity. (3)
11. Using examples, explain how plant and animal breeders apply Mendel's laws in their work. (1, 10, 14, 15)
12. Explain the four breeding practices: artificial selection, inbreeding, outbreeding, and use of the test cross. (1, 10, 15)
13. Illustrate the interaction of heredity and environment in the development of an individual. (31)

Chapter 20

1. Explain how sex is determined in humans. (5)
2. Explain, give an example of, and (using a Punnett square) work out problems in sex linkage. (17, 18, 19)
3. Explain and give examples of nondisjunction. (10, 20)
4. Explain how gene maps were worked out for *Drosophila*. (4, 22)
5. Describe the types, significance, and practical uses of mutations. (13, 15, 31)
6. Explain what alleles are and how they come to exist in a population. (3, 23)
7. Explain the origin and inheritance of multiple alleles. Use the inheritance and action of A, B, and O blood types of illustrate multiple alleles. (25, 28)
8. Explain how multiple gene inheritance accounts, at least in part, for the gradations of phenotypes seen in a population. (28)
9. Describe some of the discoveries that led to the understanding that genes are made of DNA, including work done by Miescher; Griffith, Avery, McCarty, and MacLeod; and Hershey and Chase. (30)
10. Explain the one gene-one enzyme hypothesis and the work done by Beadle and Tatum that led to it. (30)
11. Describe PKU as an example of the relationship between gene and enzyme. (31)
12. Outline how genes control traits through protein synthesis. (1, 14, 30)
13. Using sickle-cell disease as an example of a condition resulting from a mutated gene, relate gene mutations to the genetic code. (15)
14. Describe three techniques used in modern genetics research: genetic recombination, banding, and gene mapping of human chromosomes. (2, 4, 6, 11)

Chapter 21

1. Describe and give examples of the ancient theory of abiogenesis (spontaneous generation). (5)
2. Show how Redi's work disproved abiogenesis. (16)
3. Show how Pasteur's work disproved abiogenesis of microorganisms. (12)
4. Describe the heterotroph hypothesis, including mention of the primitive conditions on earth, the substances in the atmosphere, and available energy sources. (15, 18, 19, 20)
5. Explain the significance of the arrival of autotrophs for the continuance of life on earth. (11)
6. Explain how Miller's and Urey's experiment and the work of Fox support the heterotroph hypothesis. (15, 20)
7. Using examples, describe ways that fossils are formed and explain how fossils are dated. (2, 3, 6, 21)
8. Describe a theoretical order of appearance of life on earth based on fossil evidence. (21, 22)
9. Show how fossils reveal changes within a species, extinction, and relationships between species. (22)
10. Show how structural similarities, similar stages in embryonic development, vestigial organs, and biochemical similarities provide clues about relationship. (1, 2, 3)
11. Show how isolation studies and results obtained from breeding and mutation experiments provide information about changes in species. (24)
12. Describe Lamarck's theory explaining evolution and explain why it is not accepted. (9, 14)
13. Describe the theory of natural selection as conceived by Darwin and Wallace. (8, 13, 26)
14. Describe the modern version of the theory of natural selection and use it to interpret the changes in England's peppered moth population over the past two centuries. (26, 27)

Chapter 22

1. Identify the roles of producers, consumers, and decomposers in the ecosystem. (1, 6, 7, 17, 18)
2. Identify five types of consumers. (7, 11, 12, 17)
3. Explain the passage of food through food chains and food webs. (5, 16, 19, 20)
4. Describe the transfer of energy through food chains. (13, 19, 21)
5. Explain why energy must constantly be supplied to an ecosystem. (13)
6. Relate the number of links in a food chain to the amount of energy available to the final consumer. (21)
7. Construct an energy pyramid. (21)
8. Diagram the general way in which materials cycle in the ecosystem and describe the water cycle, carbon cycle, and nitrogen cycle in detail. (2, 3, 8, 15, 18, 23, 25)
9. Describe the five types of symbiotic relationships among organisms, including examples of each. (4, 9, 10, 27, 28, 29, 30)

Chapter 23

1. Identify the pattern of growth by repeated doubling characteristic of certain populations. (2, 16, 20)
2. Explain the need for regulation of population size in a balanced ecosystem. (1, 3, 6)
3. Identify the factors that are responsible for population growth and those responsible for checking growth. (11, 14, 15, 16)
4. Identify S-shaped and J-shaped curves as two patterns characteristic of population growth. (5, 20, 23)
5. Explain the concept of the carrying capacity of an ecosystem and describe the relationship between carrying capacity and population density. (1, 11, 17)
6. Use examples to show how a dynamic equilibrium in population size in an ecosystem is achieved by changes in the rates of birth, death, immigration, and emigration. (9, 10, 12, 13, 21, 22)
7. Identify the growth pattern for the human population. (22)
8. Describe the factors that affect human population size.
9. List ways that humans can bring their population size and the carrying capacity of their ecosystem into balance. (13)

Chapter 24

1. Describe the process of dispersal, including causes, barriers, results, and adaptations. (2, 8, 16, 17)
2. Explain the concepts of habitat and niche. (9, 30)
3. Describe ecological succession. Give examples, including lake to forest succession. (18, 19, 20)
4. Demonstrate that biomes are defined in terms of climax vegetation. (1)
5. Briefly describe the outstanding features of the environment and inhabitants of the six major biomes. (11, 12, 13, 14, 21-26)
6. Relate the concepts of biome and life zone. (15)
7. List and give examples of the main types of organisms found in aquatic food webs. (4, 27, 30)
8. Briefly describe the physical and chemical characteristics and inhabitants of the four major aquatic ecosystems. (5, 6, 12, 27, 28, 29)

Chapter 25

1. Distinguish between inherited and learned behavior. (11, 12, 17, 18)
2. Describe and give examples of tropisms in plants and kineses, taxes, reflexes, and instincts in protists and animals. (6, 12, 18, 20)
3. Explain how the theory of releasers explains stereotyped behavior. (12, 20)
4. Define *learning*. (2, 11)
5. Describe and give examples of habituation, imprinting, classical conditioning, and operant conditioning. (11, 21, 23)
6. Define *memory* and give examples of long-term and short-term memory. (9, 21)

Chapter 25 (continued)

7. Explain the relationship between reasoning, memory, and intelligence. (24)
8. Give examples of behavior that is affected by cyclic natural events. (7, 10)
9. Present evidence to support the existence of biological clocks in plants and animals. (13, 25)
10. Describe and give examples of photoperiodism. (13, 16, 25)
11. Describe and give examples of migration. (8, 26)
12. Explain what pheromones are and give two examples of how pheromones are used by species. (17)
13. Give an example showing how touch is used in communication in animals. (20)
14. Give examples of how sound and hearing are used during communication. (27)
15. Give examples of how an animal uses visual signals in communication. (28)
16. Describe the general characteristics of an insect society. (1, 3)
17. Describe social behavior in a honeybee society. (28)
18. Describe the general characteristics of a vertebrate society. (1, 14, 15, 29)
19. Describe how rituals, territoriality, and social dominance reduce aggression in vertebrate societies. (29)
20. Describe social behavior in a baboon troop. (14)

Chapter 26

1. List five causes of body malfunction and give an example of each. (16)
2. List five environmental factors that can cause disease and give an example of each. (7, 17, 23, 25)
3. Describe the possible effects of using tobacco, alcohol, and drugs. (12, 15, 18, 19, 20, 21)
4. Explain what infectious organisms are and give an example of a communicable and noncommunicable infectious organism. (11, 22, 24)
5. List the five ways that infectious diseases are transmitted and give an example of each. (22, 24, 25)
6. Explain the nature of epidemics. (8, 23)
7. List the six major types of disease organism and state a disease caused by each. (24)
8. Describe how the three lines of defense protect the body against disease. (1, 9, 13, 26, 27)
9. Describe the roles of Pasteur, Lister, Koch, and Jenner in the conquest of disease. (28, 29)
10. Explain how a vaccine works. (2, 30)
11. State the differences between active and passive immunity. (14)
12. Explain the use of chemotherapy and give three examples of diseases in which it has been used effectively. (3, 6, 31)
13. Use an example to illustrate how epidemiology aids in combatting disease. (8, 23)
14. Give examples to show how modern technology aids in the diagnosis and treatment of disease. (3, 6, 14, 30, 32)

PART **3**

Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. The biological classification system uses categories. From general to specific the categories are:
- kingdom, phylum, family, order, class, genus, species
 - species, genus, family, order, class, phylum, kingdom
 - kingdom, phylum, class, order, family, genus, species
 - phylum, genus, species, class, order, family, kingdom
- _____ 17. If two organisms are classified in the same family, which other classification groups **MUST** they be in together?
- all the groups more specific than family
 - none, they are only in the same family
 - all of the groups, since family is most specific
 - all the groups more general than family
- _____ 18. Which is the correct way to write the scientific name for sugar maple tree?
- acer saccharum
 - Acer saccharum*
 - A. saccharum
 - Acer Saccharum*
- _____ 19. Which of the following is **NOT** a criterion for classifying organisms?
- similarity in body structure
 - similarity in habitat
 - similarity in blood composition
 - similarity in reproduction and development
- _____ 20. How would a taxonomist determine whether a newly discovered group of tropical birds represents hybrids of two species or a distinct species of its own?
- Compare the external structures of birds within the group.
 - Determine in what genus the birds belong.
 - See if the birds can interbreed to produce similar offspring.
 - Study the geographical distribution of the birds.
- _____ 21. Why aren't viruses classified in the Moneran Kingdom?
- Viruses are not organized as cells and may not be "living" organisms.
 - All viruses are parasites; all monerans are free living.
 - The structure of viruses is very simple.
 - Viruses are prokaryotes; monerans are eukaryotes.
- _____ 22. Which statement about paramecia is **FALSE**?
- Paramecia are in the Protist Kingdom.
 - Paramecia are unicellular protozoans.
 - Paramecia use hairlike cilia to move through water.
 - Paramecia are simple, producer organisms.

- _____ 23. Which characteristic do organisms in the Fungal Kingdom have in common?
- a) Most are unicellular. c) Most are decomposers.
b) All have vascular tissue. d) All are highly poisonous.
- _____ 24. Which of the following statements about plants is FALSE?
- a) Plants produce their own food.
b) The Plant Kingdom includes all organisms having chlorophyll.
c) Plants do not move from place to place.
d) The Plant Kingdom includes only multicellular organisms.
- _____ 25. Why are tracheophytes a unique group of plants?
- a) They possess flowers and seeds.
b) They have true roots, stems, and leaves.
c) They live in the water.
d) They have two cotyledons.
- _____ 26. From general to specific, how should a bean plant be classified?
- a) Plant Kingdom, tracheophyte, angiosperm
b) Plant Kingdom, bryophyte, non-seed producing
c) Plant Kingdom, green algae, multicellular
d) Plant Kingdom, tracheophyte, gymnosperm
- _____ 27. Which of the following phyla do not contain wormlike organisms?
- a) Poriferans b) Platyhelminthes c) Nematodes d) Annelids
- _____ 28. Which of the following animals is NOT an arthropod?
- a) grasshopper b) spider c) crayfish d) snail
- _____ 29. Which of the following is a characteristic UNIQUE to chordates?
- a) breathe through gills
b) able to move about freely
c) presence of a notochord sometime in the organism's life
d) presence of vertebrae surrounding a spinal cord
- _____ 30. Which of the following groups of organisms does NOT represent a vertebrate?
- a) bird b) amphibian c) lancelet d) reptile
- _____ 31. What do reptiles and amphibians have in common?
- a) Both breathe with lungs for their entire lives.
b) Both spend part of their lives in water.
c) Both have scales and dry skin.
d) Both are coldblooded.
- _____ 32. Which characteristic is UNIQUE to mammals?
- a) lungs b) warmblooded c) vertebrae d) mammary glands

CHAPTER 3 The Cell: Basic Unit of Life

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|--|--------------------------|
| _____ 1. uses enzymes to digest materials in the cell | a) cell membrane |
| _____ 2. controls all functions of the cell | b) cell wall |
| _____ 3. structure in plant cells that contains chlorophyll | c) centriole |
| _____ 4. site of protein production in the cell | d) chloroplast |
| _____ 5. small cylindrical structure made up of microtubules that functions during cell reproduction | e) chromosome |
| _____ 6. system of folded membranes found in cell cytoplasm | f) endoplasmic reticulum |
| _____ 7. regulates what goes in and out of the cell | g) Golgi apparatus |
| _____ 8. composed of molecules that carry information about heredity | h) lipid |
| _____ 9. stores food, water, and other materials within the cell | i) lysosome |
| _____ 10. produces energy for the cell | j) microfilament |
| | k) mitochondrion |
| | l) nuclear membrane |
| | m) nucleus |
| | n) ribosome |
| | o) vacuole |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

cell membrane	hypothesis	nucleus
cell theory	lipids	objective
cellulose	micrograph	scientific method
chloroplast	microscope	vacuole

- | | |
|-------|--|
| _____ | 11. Scientists did not know very much about tiny living things until the invention of the _____ . |
| _____ | 12. The electron microscope makes a picture of a magnified object. This picture is called a(n) _____ . |
| _____ | 13. Scientists use an organized way to answer questions, called the _____ . |
| _____ | 14. All cellular organelles except the _____ and the _____ are part of the cytoplasm. |
| _____ | 15. Plants have cell walls made of _____ . |

PART

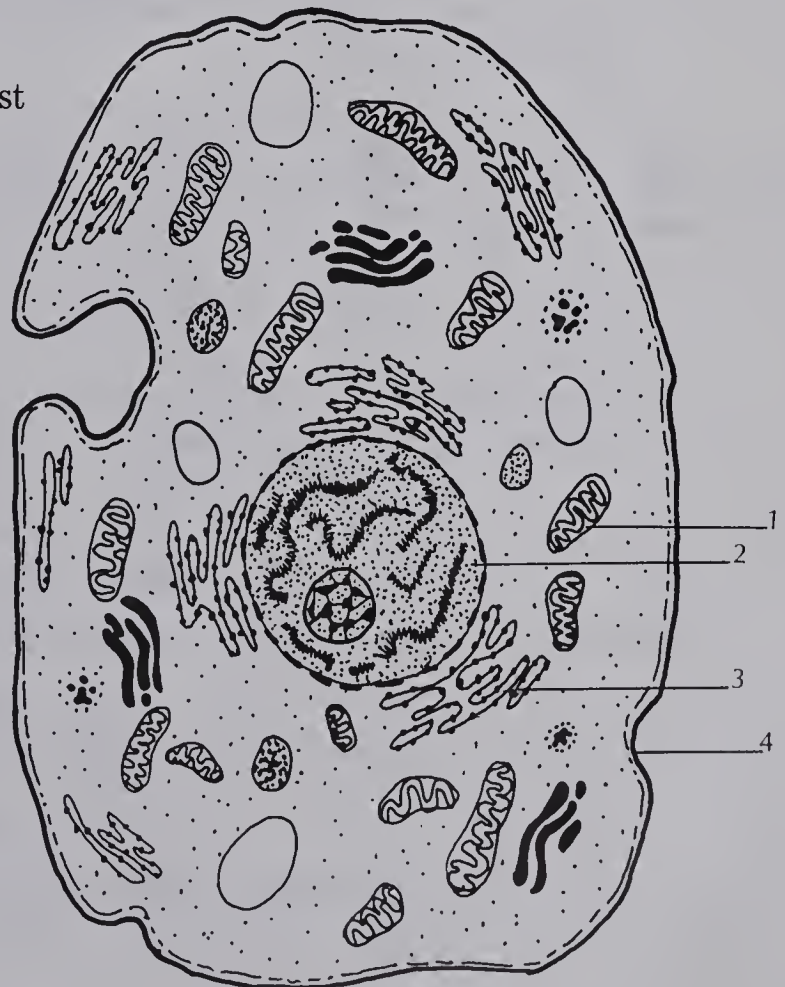
Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. The first person to use a microscope to look at living things was:
a) Robert Hooke c) Antony van Leeuwenhoek
b) Robert Brown d) Theodore Schwann
- _____ 17. Electron microscopes are helpful in research today because:
a) they can magnify an object 1000 times.
b) scientists can look at living specimens with them.
c) the object being studied can be magnified 100 000 times.
d) they allow more light to pass through the specimen.
- _____ 18. A simple microscope has:
a) two lenses. c) an objective and an eyepiece.
b) only one lens. d) lenses in each eyepiece.
- _____ 19. Who first used the word *cell* while describing a sliver of cork?
a) Robert Hooke c) Robert Brown
b) Matthias Schleiden d) Antony van Leeuwenhoek
- _____ 20. The symbol μm represents a small unit of measure called the:
a) micrograph b) millimetre c) centimetre d) micrometre
- _____ 21. Which of the following statements is most likely to be a hypothesis?
a) The Golgi apparatus was observed in cells thought to be involved with secretion.
b) The Golgi apparatus plays a role in the process of secretion.
c) Electron micrographs show the Golgi apparatus produces secretory vesicles.
d) It was concluded the Golgi apparatus functions in secretion.
- _____ 22. Which statement below is NOT a part of the cell theory?
a) Cells are the basic unit of structure in living things.
b) Cells come from pre-existing cells.
c) Cells are made up of specialized organelles.
d) Cells carry out basic life functions.
- _____ 23. Two identical laboratory growth chambers are used in a controlled experiment with lettuce plants. Ten lettuce plants are in a chamber with 12 hours of light, 30°C air temperature, and receive 10 mL of water every day. Another ten lettuce plants are in a chamber with 12 hours of light, 20°C air temperature, and receive 10 mL of water every day. The experimental variable is:
a) light c) amount of water
b) temperature d) number of plants

- _____ 24. Which of the following statements relating to the scientific method involving a controlled experiment is CORRECT?
- The experiment's results help to indicate whether the hypothesis is correct.
 - The experiment should have more than one variable.
 - The experiment is set up to see if the observations are correct.
 - The results must support the hypothesis.
- _____ 25. Specialization in a multicellular organism means that:
- each cell performs all the functions of the body.
 - each organelle or cell has a specific function.
 - each cell can carry on all life functions.
 - each organelle performs every job of the cell.
- _____ 26. The type of membrane that allows only certain molecules to go in and out is called:
- permeable
 - plasma
 - double
 - semi-permeable
- _____ 27. Prokaryotic and eukaryotic cells differ in several basic ways. However, one of the structures listed below is found in both types of cells. Which structure do they have in common?
- chromosomes
 - mitochondria
 - nuclear membrane
 - chloroplasts

In answering questions 28 through 31, refer to the diagram of a typical animal cell.

- _____ 28. What is structure 1?
- mitochondrion
 - vacuole
 - chloroplast
 - nucleus
- _____ 29. What is structure 2?
- ribosome
 - vacuole
 - nucleus
 - nucleolus
- _____ 30. What is structure 3?
- cytoplasm
 - endoplasmic reticulum
 - nucleolus
 - nuclear membrane
- _____ 31. What is structure 4?
- cell wall
 - lysosome
 - nuclear membrane
 - cell membrane



CHAPTER 4 The Molecular Machinery of the Cell

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|---|----------------------|
| _____ 1. event during which atoms rearrange by breaking and reforming of bonds | a) active site |
| _____ 2. smallest particle of an element | b) atom |
| _____ 3. place where a substrate molecule attaches to an enzyme | c) ATP |
| _____ 4. pure chemical substance | d) catalyst |
| _____ 5. type of bond that forms between atoms that share some of their outer electrons | e) centrifuge |
| _____ 6. two or more atoms of different elements joined by covalent bonds | f) chromatography |
| _____ 7. molecule that stores energy in cells | g) chemical equation |
| _____ 8. substance that affects the rate of a chemical reaction | h) chemical reaction |
| _____ 9. atom or molecule with an electrical charge | i) compound |
| _____ 10. technique for separating molecules contained in a substance | j) covalent bond |
| | k) element |
| | l) ion |
| | m) ionic bond |
| | n) molecule |
| | o) proton |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

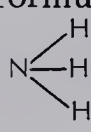
acidic
basic
covalent
electron

inorganic
ionic
neutron
organic

peptide
polypeptide
proton
sucrose

- | | |
|-------|--|
| _____ | 11. The particle in an atom which has a negative charge is called the _____. |
| _____ | 12. A solution with a pH of 2 is _____. |
| _____ | 13. Compounds that contain carbon and hydrogen are called _____ compounds. |
| _____ | 14. In a(n) _____ bond atoms transfer electrons. |
| _____ | 15. The chemical bond between two amino acids is called a(n) _____ bond. |

PART **3** Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. Which statement comparing the chemical substances found in a rock with those found in a bean plant is TRUE?
- The substances are the same and combined in the same way.
 - The substances are completely different.
 - The elements in both are the same but the amounts of each element varies.
 - The elements in both have the same names but are chemically different.
- _____ 17. What causes the atoms of one element to be different from the atoms of another element?
- different numbers of electrons
 - different numbers of neutrons
 - different numbers of outer electrons
 - different numbers of protons
- _____ 18. How is the O^{-2} ion (oxygen with two negative charges) formed?
- An oxygen atom lost two protons.
 - An oxygen atom gained two electrons
 - Two neutrons joined an oxygen nucleus.
 - An oxygen atom lost two electrons.
- _____ 19. Which of the following is a molecule but not a compound?
- S_8
 - H_2SO_4
 - SO_2
 - S
- _____ 20. What information is communicated by the structural formula shown?
- This molecule has a double bond.
 - The atoms are held together by ionic bonds.
 - Nitrogen and hydrogen atoms are held together by covalent bonds.
 - The hydrogen atoms take electrons from the nitrogen atom.
- 
- _____ 21. In which of the following cases is a chemical reaction being slowed down?
- baking a cake
 - lighting a match
 - storing medicines in the refrigerator
 - frying an egg on the stove
- _____ 22. Which of the following is NOT a carbohydrate?
- fructose
 - glycerol
 - cellulose
 - disaccharide
- _____ 23. The basic units of lipids are called:
- simple sugars
 - hydrocarbon chains
 - amino acids
 - fatty acids
- _____ 24. Which is NOT a part of a nucleotide?
- phosphate group
 - nucleic acid
 - nitrogen base
 - simple sugar

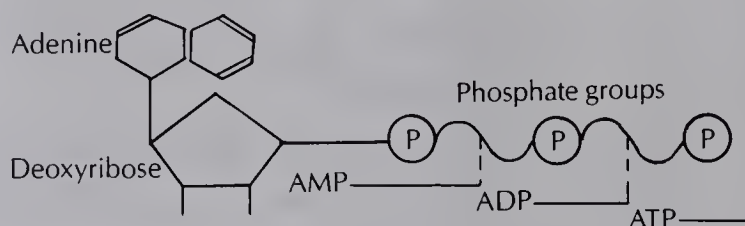
- _____ 25. The diagram represents a tube containing cells that have been centrifuged. What is the difference between layers x, y, and z.

- a) x contains heavier structures than y or z.
- b) x contains atoms, y contains elements, z contains compounds.
- c) x dissolves in the solvent, z does not.
- d) x is lightest in weight, z is heaviest.



- _____ 26. The diagram shows the basic structure of the nucleotides AMP, ADP, and ATP. The wavy lines represent chemical bonds that store large amounts of energy. Which molecule contains the most energy?

- a) AMP
- b) ADP
- c) ATP
- d) energy is equal in the three



- _____ 27. The conversion of energy that takes place when gasoline is burned is:

- a) heat energy to chemical energy.
- b) nuclear energy to mechanical energy.
- c) mechanical energy to electrical energy.
- d) chemical energy to mechanical energy and heat.

- _____ 28. Can a lump of coal sitting still be thought of as having energy?

- a) yes, because when burned the coal releases heat
- b) no, because the coal is not moving
- c) yes, because the coal has kinetic energy
- d) no, because the coal cannot cause change

- _____ 29. What is activation energy?

- a) energy needed to start a chemical reaction
- b) energy given off during a chemical reaction
- c) energy absorbed during a chemical reaction
- d) a type of kinetic energy

- _____ 30. Which of these statements about how enzymes work is TRUE?

- a) They increase the amount of product formed during a reaction.
- b) They attach to the products.
- c) They decrease the activation energy needed to begin a reaction.
- d) They are equally effective at all pH and temperature ranges.

- _____ 31. What type of reaction is described by the equation: maltose + water → glucose?

- a) synthesis
- b) catalysis
- c) hydrolysis
- d) dehydration synthesis

CHAPTER 5 Food Production and Nutrition

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|---|---------------------|
| _____ 1. molecule that transports electrons, protons, and energy within the cell | a) amino acid |
| _____ 2. food-producing process in plants and algae | b) beriberi |
| _____ 3. layer of wax on upper surface of leaves | c) calorimeter |
| _____ 4. disease resulting from deficiency of vitamin B ₁ | d) cuticle |
| _____ 5. colored substance which absorbs light | e) dark reactions |
| _____ 6. device used to measure the amount of energy stored in food | f) electron carrier |
| _____ 7. tubelike structure which brings water to leaf cells | g) guard cell |
| _____ 8. stage of photosynthesis during which glucose is synthesized | h) light reactions |
| _____ 9. inorganic nutrient important for the formation and functioning of body parts | i) mineral |
| _____ 10. process of obtaining and using food | j) nutrition |
| | k) photosynthesis |
| | l) pigment |
| | m) rickets |
| | n) vein |
| | o) vitamin |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

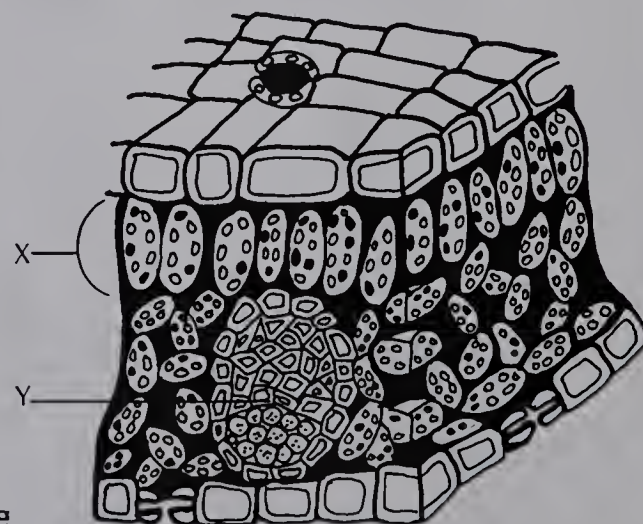
calorie	chlorophyll	oxygen
Calvin	de Saussure	Priestly
carbohydrates	lipids	van Helmont
carbon dioxide	minerals	vitamins

- | | |
|-------|---|
| _____ | 11. Green plants are essential to other organisms because they supply them with nutrients and _____. |
| _____ | 12. A seventeenth-century Belgian named _____ investigated plant growth by comparing soil and plant masses of a potted willow tree over a five-year period. |
| _____ | 13. _____ are organic substances that form part of the structure of many enzymes. |
| _____ | 14. All _____ are considered to be nonessential nutrients. |
| _____ | 15. Research performed by _____ helped explain the actual chemical steps involved in photosynthesis. |

PART **3**

Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. Which statement concerning photosynthesis is FALSE?
- The basic photosynthetic process is the same in algae and rose plants.
 - The hydrogen in water is used to produce glucose molecules.
 - Plants convert light energy to chemical energy.
 - Oxygen produced during photosynthesis comes from splitting carbon dioxide molecules.
- _____ 17. Which of the following equations represents the overall chemical equation for photosynthesis?
- glucose + oxygen $\xrightarrow{\text{chlorophyll}}$ carbon dioxide + water + energy
 - carbon dioxide + water $\xrightarrow[\text{chlorophyll}]{\text{energy}}$ glucose + oxygen
 - glucose + carbon dioxide $\xrightarrow{\text{energy}}$ water + oxygen
 - oxygen + water $\xrightarrow[\text{chlorophyll}]{\text{energy}}$ glucose + carbon dioxide
- _____ 18. The primary function of a leaf is to:
- protect the plant from drying out.
 - produce food for the plant.
 - transport water to the chloroplasts.
 - store food as starch for the plant.
- _____ 19. Which specialized cells in the leaf help to minimize water loss in some plants?
- guard cells
 - stomates
 - cells in the spongy layer
 - cells in the palisade layer
- _____ 20. Referring to the diagram of a leaf in cross section, identify structure X:
- stomate
 - palisade layer
 - spongy layer
 - epidermis
- _____ 21. Structure Y in the diagram above is a(n):
- vein (vascular bundle)
 - guard cell
 - cuticle
 - air space



_____ 22. Chlorophyll pigment:

- a) makes leaves turn red.
- b) gives beets their red color.
- c) absorbs green light.
- d) reflects green light.

_____ 23. How is a chloroplast put together?

- a) an outer membrane, stroma, and grana made up of thylakoid discs
- b) composed of thylakoid discs made up of grana
- c) composed of grana made up of stroma
- d) an outer membrane, grana, and stroma containing chlorophyll

_____ 24. Energized electrons that leave chlorophyll molecules are replaced by:

- a) electrons from NADPH molecules.
- b) protons from a second set of chlorophyll molecules.
- c) protons from glucose molecules.
- d) electrons from the splitting of water molecules.

_____ 25. The process that occurs during the light reactions is:

- a) formation of ATP and NADPH molecules.
- b) conversion of glucose to starch.
- c) release of energy from glucose molecules.
- d) synthesis of glucose molecules.

_____ 26. Which substance is NOT used by plants to synthesize organic nutrients?

- a) glucose
- b) lipids
- c) minerals
- d) nitrogen

_____ 27. Proteins are used by the human body:

- a) to help maintain proper blood pressure.
- b) as sources of simple sugars.
- c) by being converted to fat and stored.
- d) as sources of essential amino acids.

_____ 28. Which nutrient will provide energy the fastest?

- a) lipids
- b) carbohydrates
- c) minerals
- d) amino acids

_____ 29. Which of the following is NOT a food source for vitamin C?

- a) citrus fruits
- b) whole grains
- c) tomatoes
- d) green peppers

_____ 30. A rich dessert has 150 Cal per serving. If you tested this claim using a calorimeter, burning one serving should raise 5 kg of water:

- a) 50°C
- b) 10°C
- c) 30°C
- d) 150°C

_____ 31. Which of these situations requires the most energy?

- a) 60 kg man eating a hamburger
- b) 50 kg man sitting and reading
- c) 50 kg man running
- d) 65 kg man sleeping

CHAPTER 6 Obtaining Energy from Food

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|--|-------------------------|
| _____ 1. shelflike structure formed by the inner membrane of a mitochondrion | a) aerobic |
| _____ 2. complex process by which energy is released from the breakdown of glucose molecules | b) anaerobic |
| _____ 3. requiring the presence of oxygen to live and grow | c) biochemical pathway |
| _____ 4. electron carrier molecule produced during glycolysis and the citric acid cycle | d) breathing |
| _____ 5. condition of lowered body temperature | e) cellular respiration |
| _____ 6. all the chemical reactions in an organism | f) citric acid |
| _____ 7. sequence of enzyme reactions in a cell | g) crista |
| _____ 8. condition during which body temperature and metabolism are lowered for a period of time | h) electron transport |
| _____ 9. type of alcohol produced during fermentation | i) ethanol |
| _____ 10. speed of chemical reactions in the body | j) glycolysis |
| | k) hibernation |
| | l) hypothermia |
| | m) metabolic rate |
| | n) metabolism |
| | o) NADH |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

ADP	citric acid	heat
aerobic	ethanol	lactic acid
anaerobic	glycolysis	NAD ⁺
ATP	H ⁺	oxygen

- | | |
|-------|--|
| _____ | 11. Fermentation is a(n) _____ reaction. |
| _____ | 12. During the process of fermentation, pyruvic acid is converted to _____ in muscle cells, or _____ in yeast cells. |
| _____ | 13. Most of the cell's ATP is made during the _____ stages of cellular respiration. |
| _____ | 14. An important electron carrier in the citric acid cycle is _____. |
| _____ | 15. Energy from glucose is released during cellular respiration and stored in _____. |

PART 3

Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

_____ 16. The energy released during cellular respiration comes from:

- a) energy in carbon dioxide molecules. c) heat energy.
- b) energy stored in glucose molecules. d) ATP.

_____ 17. How are ADP and ATP related?

- a) They are identical except ADP has more energy.
- b) ADP has one more phosphate group and less stored energy than ATP.
- c) They are opposite processes.
- d) ATP has one more phosphate group and more stored energy than ADP.

_____ 18. Which statement concerning the biochemical pathway shown below is TRUE?



- a) This pathway represents a summary of the process of cellular respiration.
- b) There are four products as a result of this process.
- c) This pathway describes the synthesis of glucose molecules.
- d) During this process no energy is lost; it is all stored in ATP.

_____ 19. In order of their occurrence, the three stages of cellular respiration are:

- a) glycolysis, fermentation, citric acid cycle
- b) pyruvic acid cycle, citric acid cycle, lactic acid cycle
- c) anaerobic stage, aerobic stage, ATP production
- d) glycolysis, citric acid cycle, electron transport

_____ 20. Which process does NOT take place in the mitochondrion?

- a) glycolysis c) citric acid cycle
- b) electron transport d) ATP production

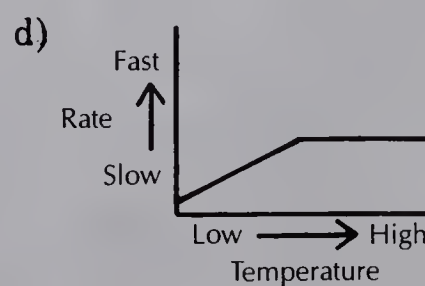
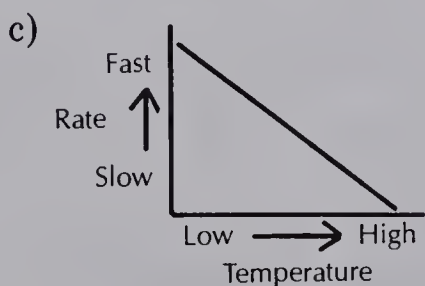
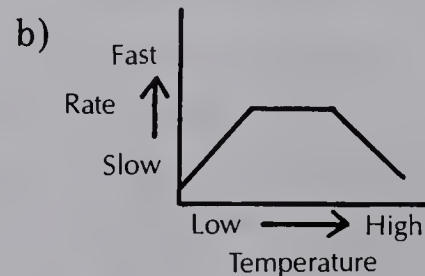
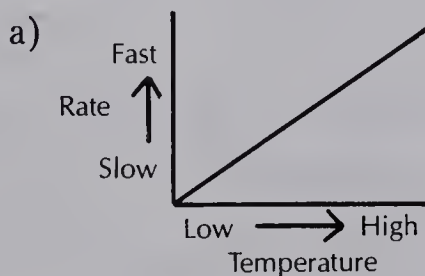
_____ 21. In the biological process of cellular respiration:

- a) oxygen and glucose combine to form carbon dioxide, water, and energy.
- b) carbon dioxide and water combine to form glucose.
- c) water and ATP react to form glucose and energy.
- d) glucose is broken into pyruvic acid and then into ethanol.

_____ 22. Photosynthesis and cellular respiration are related processes because:

- a) cellular respiration takes place before photosynthesis can occur.
- b) each supplies the raw materials for the other.
- c) photosynthesis is one part of cellular respiration.
- d) cellular respiration produces ATP; photosynthesis uses ATP.

- _____ 23. The energy released as electrons are passed along carrier molecules during electron transport is used to make molecules of:
a) ATP b) ADP c) NADH d) NAD^+
- _____ 24. The final electron acceptor in cellular respiration is:
a) water b) oxygen c) carbon dioxide d) NADH
- _____ 25. When ATP is broken down during metabolic reactions, some of its energy is released as:
a) ADP b) oxygen c) heat d) carbon dioxide
- _____ 26. Which type of nutrient can be used during respiration to produce energy?
a) amino acids b) glucose c) fatty acids d) all three
- _____ 27. Suppose you are going on a winter camping trip and are concerned about keeping the weight of food and gear down. Which type of food will supply the most energy for the least weight?
a) lipids b) proteins c) starches d) simple sugars
- _____ 28. Why do warmblooded animals have high metabolic rates?
a) Constant, warm body temperatures increase enzyme activity. ✓
b) Use of ATP is slow at warm temperatures.
c) Chemical reactions slow down at temperatures over 40°C .
d) Warmblooded animals eat small amounts of food.
- _____ 29. Which of the following is a description of coldblooded animals?
a) They have a fairly constant rate of metabolism.
b) Their body temperature is close to the environmental temperature.
c) All coldblooded animals hibernate during the cold months.
d) They have body coverings of hair, fur, or feathers.
- _____ 30. Which graph most accurately depicts the actual relationship between metabolic rate and temperature?



CHAPTER **7** **Gas Exchange**

PART **1** Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|--|-------------------------|
| _____ 1. process during which food energy is used to synthesize ATP | a) alveolus |
| _____ 2. exchange of oxygen and carbon dioxide through a cell membrane | b) breathing |
| _____ 3. group of organs that work together to accomplish gas exchange | c) bronchiole |
| _____ 4. opening on underside of leaf which allows gas exchange | d) capillary |
| _____ 5. very thin-walled blood vessel | e) cellular respiration |
| _____ 6. tiny air sac in the lungs | f) hemoglobin |
| _____ 7. cell containing hemoglobin molecules | g) homeostasis |
| _____ 8. protein molecule in blood which bonds easily with oxygen | h) lenticel |
| _____ 9. tendency in organisms to maintain stable internal conditions | i) red blood cell |
| _____ 10. area in the brain which regulates the breathing rate | j) respiration |
| | k) respiratory center |
| | l) respiratory system |
| | m) spiracle |
| | n) stomate |
| | o) white blood cell |

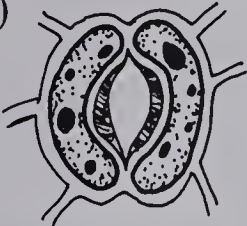

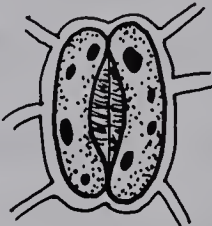
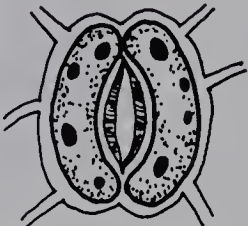
PART **2** Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

- | | | |
|----------------------|--------------|------------|
| breathing | endoskeleton | oxygenated |
| carbon dioxide | exoskeleton | spiracle |
| cellular respiration | lenticel | stomate |
| deoxygenated | oxygen | water |

- | | |
|-------|--|
| _____ | 11. Some animals have a hard outer covering called a(n) _____, which provides protection against water loss. |
| _____ | 12. An opening for gas exchange in the body of a grasshopper is called a(n) _____. |
| _____ | 13. When hemoglobin is carrying oxygen, the blood is said to be _____. |
| _____ | 14. For cellular respiration to occur, _____ must reach cells and _____ must leave cells. |
| _____ | 15. The process of inhaling and exhaling air is known as _____. |

PART **3**

Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. Which of the following is NOT a basic step in respiration?
- Carbon dioxide moves through a moist membrane.
 - Oxygen moves into the trachea through the mouth.
 - Oxygen is transported to all cells of an organism.
 - Carbon dioxide is expelled through a moist membrane.
- _____ 17. Which of the following organisms has a true respiratory system?
- hydra
 - earthworm
 - paramecium
 - fish
- _____ 18. Why are stomates open during photosynthesis?
- allow carbon dioxide to move into the leaf
 - allow water to be absorbed by the plant
 - allow passage of oxygen out of the leaf
 - allow water to leave the guard cells
- _____ 19. Which diagram depicts guard cells at night?
- 
 - 
 - 
 - 
- _____ 20. In the wintertime what sort of gas exchange takes place in trees that have shed their leaves?
- Carbon dioxide is coming in through stomates and oxygen is going out.
 - Oxygen is coming in through lenticels and carbon dioxide is going out.
 - Oxygen from photosynthesis is being used for respiration.
 - The tree dies, so no gas exchange is taking place.
- _____ 21. In order for oxygen to pass from the surroundings into a paramecium's body what must be TRUE?
- There must be more oxygen on the inside than outside.
 - The membrane of the cell must be moist.
 - There must be more carbon dioxide on the inside than outside.
 - The paramecium must have a respiratory system.
- _____ 22. How is gas exchange accomplished in the hydra?
- The hydra moves gases through blood vessels.
 - The hydra has gills for gas exchange.
 - Gases move between the water and the hydra's cells.
 - Lungs are used to take in oxygen and give off carbon dioxide.

_____ 23. What function does mucus serve during respiration in earthworms?

- a) helps keep the skin moist so gas exchange can occur
- b) as a secretion it helps the earthworm move through the soil
- c) transports oxygen throughout the earthworm's body
- d) serves no function during respiration

_____ 24. Which is the correct sequence for tracing movement of an oxygen molecule from the air to the inside of a cell in a grasshopper?

- a) air → spiracles → bronchioles → alveoli → cell
- b) air → trachea → spiracles → cell membrane → cell
- c) air → spiracles → trachea → cell membrane → cell
- d) air → trachea → lungs → cell membrane → cell

_____ 25. How is air moved into and out of the lungs in humans?

- a) The diaphragm and chest muscles work together to expand or decrease the size of the chest cavity.
- b) The diaphragm moves up and down to force air into the lungs.
- c) Chest muscles relax during inhalation and contract during exhalation.
- d) Air is swallowed and forced into the lungs.

_____ 26. In tracing the path of oxygen into a human lung (below), what is the missing step?

mouth → trachea → ? → bronchiole → alveolus

- a) bronchus b) pharynx c) capillary d) larynx

_____ 27. In humans, the specific point of gas exchange is:

- a) between air and lungs. c) between alveoli and capillaries.
- b) between lungs and trachea. d) between bronchioles and alveoli.

_____ 28. Pneumonia is a disease in which the alveoli of the lungs become filled with fluid. Blood coming from an infected lung often carries much less oxygen than normal. What might be the reason?

- a) Oxygen dissolves better in liquids than in air.
- b) The chest cavity gets smaller as the person breathes.
- c) The surface area for gas exchange has been greatly reduced.
- d) The concentration of carbon dioxide is high in the alveoli.

_____ 29. The amount of which substance in the blood is a factor in the control of breathing rate?

- a) oxyhemoglobin b) oxygen c) red blood cells d) carbon dioxide

_____ 30. As a person climbs a high mountain:

- a) their breathing rate decreases. c) more oxygen is needed.
- b) air pressure decreases. d) their breathing rate increases.

CHAPTER 8 Food Processing

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|--|---------------------|
| _____ 1. stinging cell used by hydras to capture prey | a) bile |
| _____ 2. process of getting rid of undigested material | b) colon |
| _____ 3. end of the large intestine | c) crop |
| _____ 4. food enclosed by a membrane within a cell | d) digestion |
| _____ 5. a secretion of the liver which breaks up fats and oils | e) digestive tract |
| _____ 6. part of a paramecium which helps direct food to its mouth | f) egestion |
| _____ 7. digestive tube with two openings, one at either end | g) food vacuole |
| _____ 8. another name for the large intestine | h) gallbladder |
| _____ 9. wave of muscle contractions that moves food along the digestive tract | i) gizzard |
| _____ 10. sac which stores bile | j) nematocyst |
| | k) oral groove |
| | l) pancreatic juice |
| | m) peristalsis |
| | n) rectum |
| | o) secretin |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

absorption	hormones	mechanical
chemical	intracellular	nuclease
enzymes	lipase	ulcer
extracellular	maltase	villus

- | | |
|-------|--|
| _____ | 11. Breaking apart food molecules into smaller particles by means of enzymes is called _____ digestion. |
| _____ | 12. Chemical digestion that occurs in a cavity lined by cells is termed _____ digestion. |
| _____ | 13. Gastrin and secretin are examples of _____ involved with digestion. |
| _____ | 14. _____ is one of the enzymes that breaks down carbohydrates. |
| _____ | 15. A sore caused by gastric juices "eating" a portion of the digestive tract wall is called a(n) _____. |

PART **3** Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

_____ 16. Which of the following is NOT a characteristic of consumers?

- a) get rid of food wastes
- b) store nutrients
- c) manufacture their own food
- d) break down food into nutrients

_____ 17. Digestion is best defined as:

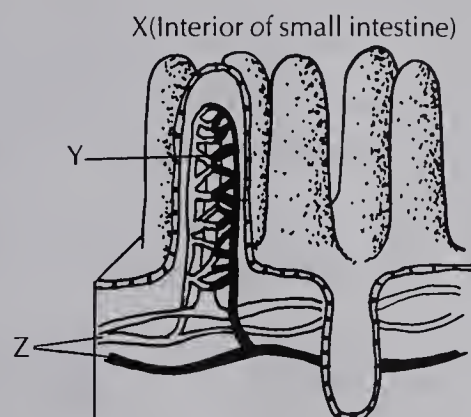
- a) the intake of food by a living organism.
- b) the process of chewing and swallowing food.
- c) the absorption of food from the digestive tract.
- d) the breakdown of food molecules into smaller molecules.

_____ 18. The process of moving nutrients from the place they were digested into the cytoplasm of cells is called:

- a) absorption
- b) digestion
- c) ingestion
- d) egestion

_____ 19. The diagram shows villi in the small intestine. Which statement is TRUE?

- a) Food in villus Y moves into the small intestine at X.
- b) Food in villus Y is absorbed into cells at Z.
- c) Digested food at X moves into blood vessels at Y.
- d) Digested food at Y is absorbed into blood vessels at X.



_____ 20. Most organisms have an adaptation that maximizes absorption of nutrients by increasing the:

- a) volume of food ingested.
- b) surface area of absorption.
- c) rate of peristalsis.
- d) stomach size.

_____ 21. How are the digestive systems of earthworms and hydras different from each other?

- a) Hydras have only one opening; earthworms have two.
- b) Earthworms secrete digestive enzymes; hydras do not.
- c) The earthworm's digestive tract is less efficient than the hydra's digestive cavity.
- d) Hydras have only intracellular digestion; earthworms only extracellular.

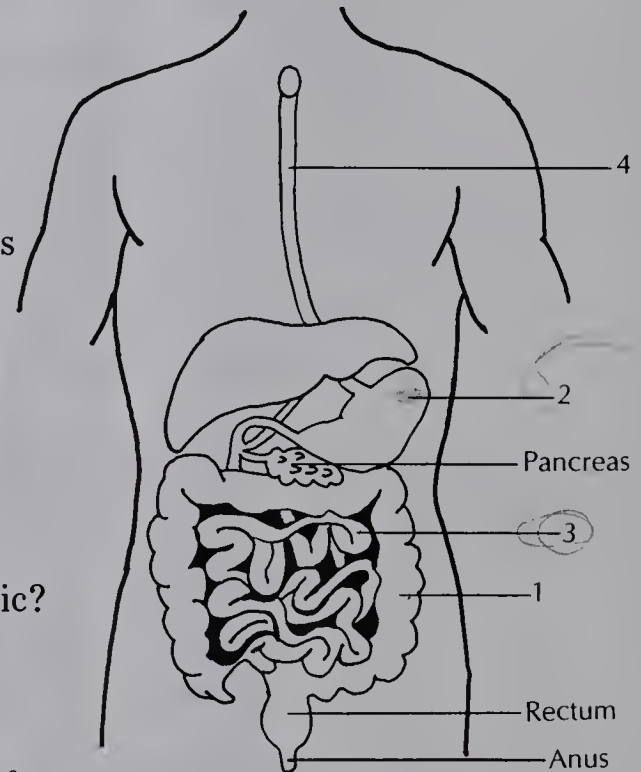
_____ 22. Which statement is TRUE for both grasshoppers and humans?

- a) There is one intestine in the digestive tract.
- b) Food is digested and absorbed in the stomach.
- c) Wastes are egested through the anus.
- d) The gizzard grinds up food.

- _____ 23. Trace the path of food through the human digestive tract.
- esophagus → stomach → small intestine → large intestine → anus
 - stomach → pancreas → liver → digestive glands
 - esophagus → stomach → digestive glands → small intestine → large intestine
 - crop → gizzard → stomach → intestine → anus
- _____ 24. Which of the following enzymes begins digestion of starch?
- lipase
 - amylase
 - protease
 - nuclease
- _____ 25. Which digestive secretion contains enzymes that digest carbohydrates, proteins, fats, and nucleic acids?
- gastric juice
 - bile
 - intestinal juice
 - pancreatic juice
- _____ 26. Which nutrient is absorbed into lymph vessels?
- simple sugars
 - amino acids
 - vitamins
 - fatty acids

Refer to the diagram of the human digestive tract in answering questions 27 through 29.

- _____ 27. What is the main function of structure 1?
- reabsorbs water, ions, and vitamins
 - completes digestion of proteins and fats
 - provides food for harmless bacteria
 - completely absorbs the digested nutrients
- _____ 28. The presence of food in structure 2 stimulates the production of:
- gastrin
 - secretin
 - intestinal juice
 - saliva
- _____ 29. At what point in the digestive tract does the pH of food undergoing digestion become basic?
- structure 4
 - structure 2
 - structure 3
 - rectum



- _____ 30. Nutrients are transported to cells by means of:
- enzymes
 - digestive juices
 - blood
 - lymph
- _____ 31. Without removing the salivary glands, how could saliva production be stopped?
- interfere with the hormone that controls saliva production
 - cut the nerves going from the brain to the salivary glands
 - eliminate carbohydrates from a person's diet
 - stop the formation of amylase
- _____ 32. Insulin and glucagon have opposite effects in controlling the level of which product of digestion in the blood?
- fatty acids
 - amino acids
 - glucose
 - vitamins

CHAPTER 9 Transport

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|---|--------------------------|
| _____ 1. pathway the blood travels from heart to lungs and back to heart | a) antibody |
| _____ 2. disease in which cholesterol builds up on the walls of arteries and blood flow is slowed | b) antigen |
| _____ 3. white blood cell | c) arteriosclerosis |
| _____ 4. tendency of liquids to cling to the sides of narrow vessels | d) capillarity |
| _____ 5. foreign substance | e) closed transport |
| _____ 6. circuit in which blood flows through vessels that open into spaces between body organs | f) cytoplasmic streaming |
| _____ 7. red blood cell | g) endocytosis |
| _____ 8. blood vessels swollen due to malfunctioning valves | h) erythrocyte |
| _____ 9. chemical substance produced by white blood cells | i) leukocyte |
| _____ 10. process by which large molecules and particles are brought into a cell | j) platelet |
| | k) open transport |
| | l) pulmonary circulation |
| | m) systemic circulation |
| | n) transpiration |
| | o) varicose veins |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

aorta	homeostasis	phloem
arteriole	hypertension	plasma
bone marrow	lacteal	vena cava
diffusion	osmosis	xylem

- | | |
|-------|---|
| _____ | 11. In humans, the transport system contributes to _____ by helping to regulate body temperature and maintaining a constant pH in tissue fluid. |
| _____ | 12. The largest artery in the body, the _____, carries blood away from the heart. |
| _____ | 13. Water molecules move by _____ into plant root cells and eventually enter _____ tubes. |
| _____ | 14. A(n) _____ is a tiny vessel in each villus of the small intestine which absorbs fatty acids into the lymph. |
| _____ | 15. Cells in the _____ produce new red blood cells and hemoglobin. |

PART **3**

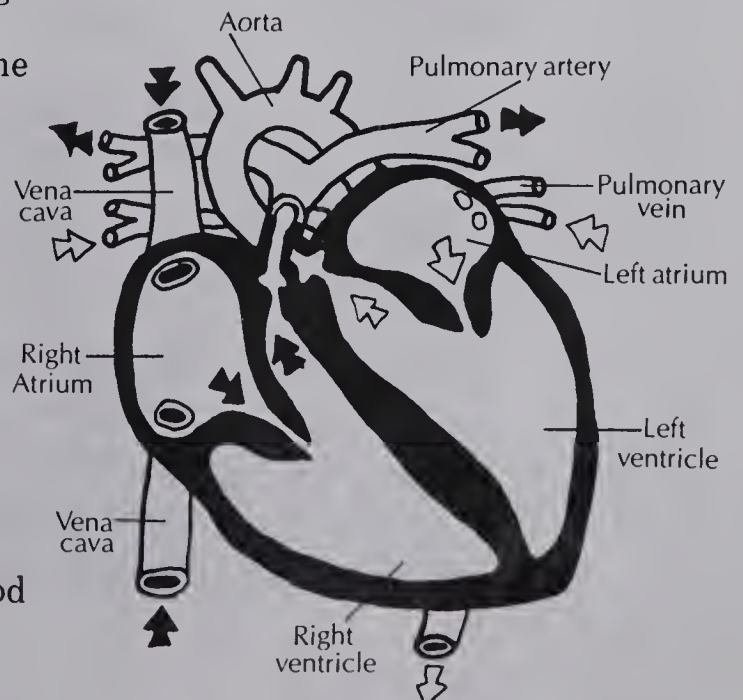
Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. Which one of the following is NOT a characteristic of transport systems?
- a) They move materials through an organism by means of a liquid.
 - b) They move liquid and materials in pathways, which are often tubes.
 - c) They allow cells to exchange nutrients and wastes by absorption.
 - d) They include some mechanism for moving liquid and materials in the organism.
- _____ 17. A drop of red food dye turns water in a glass pink. This is an example of:
- a) osmosis b) permeable membranes c) diffusion d) active transport
- _____ 18. A sac containing pure water is suspended in a container of substance X and water. After a period of time the concentrations of X inside and outside the sac are equal. Which statement is TRUE?
- a) The sac membrane is permeable to substance X and water.
 - b) Movement of substance X across the sac membrane requires energy.
 - c) The sac membrane is permeable only to water.
 - d) Substance X moves by osmosis across the sac membrane.
- _____ 19. The concentration of sodium ions gradually becomes higher within a cell than in its surrounding environment. What process is occurring?
- a) diffusion b) osmosis c) passive transport d) active transport
- _____ 20. Which statement concerning absorption of minerals and water in plants is CORRECT?
- a) Water and minerals enter the stem through the process of diffusion.
 - b) Water and minerals move into the stem attached to carrier molecules.
 - c) Minerals move into the root by active transport, water by osmosis.
 - d) Minerals move into the root by diffusion, water by osmosis.
- _____ 21. The force created by the movement of water by osmosis into a plant root is called:
- a) cohesion-tension b) transpiration c) capillarity d) root pressure
- _____ 22. Which of the three interacting forces involved in the upward movement of water in vascular plants would be active on an extremely humid day? (Assume an equal concentration of water molecules in air and leaves.)
- a) diffusion, osmosis, and active transport
 - b) cohesion-tension, capillarity, and root pressure
 - c) root pressure and capillarity only
 - d) cohesion-tension and osmosis only
- _____ 23. Which statement correctly describes the function of phloem?
- a) transports food from roots to leaves c) transports water from roots
 - b) carries nutrients from leaves d) moves water laterally

- _____ 24. What role does endocytosis play in transport in the hydra?
- mechanism for transporting food from the digestive cavity to the cells
 - process by which water enters the cells
 - mechanism for moving nutrients across vacuole membranes into the cytoplasm
 - mechanism for moving waste products out of the cells
- _____ 25. Which of the following has a closed system of vessels for transport?
- grasshopper
 - paramecium
 - hydra
 - earthworm
- _____ 26. Which of the following is NOT a function of the lymph system?
- absorbs fatty acids into the blood
 - returns lymph to the blood
 - transports hormones
 - produces white blood cells
- _____ 27. Most exchange of materials between the cells and blood takes place in:
- capillaries
 - arteries
 - veins
 - arterioles
- _____ 28. Blood supply to the body is NOT regulated by:
- nerve signals from brain to heart.
 - widening of capillaries.
 - changes in body temperature.
 - changes in heart rate.

Refer to the diagram of a human heart to answer the following questions.

- _____ 29. An important factor in blood pressure is the ability of some blood vessels to change diameter. In which vessel would blood pressure be highest?
- dilated artery in upper arm
 - constricted artery in upper arm
 - vein in upper arm
 - vein in upper leg
- _____ 30. Which is the correct pathway of blood from the heart to the lungs and back?
- vena cavae → right atrium → lungs → right ventricle
 - right ventricle → pulmonary artery → lungs → left atrium
 - left ventricle → pulmonary artery → lungs → right atrium
 - right ventricle → vena cavae → lungs → left atrium
- _____ 31. The order in which the chambers of the heart contract is:
- ventricles, then atria
 - atria, then ventricles
 - left atrium, left ventricle, right atrium, right ventricle
 - right atrium, right ventricle, left atrium, left ventricle
- _____ 32. The clear arrows represent:
- oxygen
 - plasma
 - oxygenated blood
 - deoxygenated blood



CHAPTER 10 Excretion

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|---|------------------------|
| _____ 1. nitrogenous waste that does not require water for removal | a) ammonia |
| _____ 2. process of getting rid of waste substances | b) artificial kidney |
| _____ 3. functioning unit of the kidney | c) contractile vacuole |
| _____ 4. machine that filters blood | d) diffusion |
| _____ 5. substance produced when amino acids are used for energy | e) excretion |
| _____ 6. structure in paramecia that functions in excretion | f) kidney |
| _____ 7. transport process by which ammonia, carbon dioxide, and salts leave the cells of the hydra | g) Malpighian tubule |
| _____ 8. excretory organ found in the grasshopper | h) nephridium |
| _____ 9. excretory organ of the human body that also acts to help regulate body temperature | i) nephron |
| _____ 10. process of active transport by which substances are selectively removed from the blood | j) osmosis |
| | k) respiration |
| | l) secretion |
| | m) skin |
| | n) uric acid |
| | o) urine |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

- | | | |
|--------------------|----------|-----------|
| ammonia | nephrons | urea |
| carbon dioxide | nitrogen | uric acid |
| Malpighian tubules | oxygen | urine |
| nephridia | salt | water |

- | | |
|-------|--|
| _____ | 11. The grasshopper excretes nitrogenous wastes in the form of _____. |
| _____ | 12. Human kidneys produce _____, which consists of urea, _____, and other wastes removed from the blood. |
| _____ | 13. In bean plants much of the waste product _____ is used in photosynthesis. |
| _____ | 14. Paramecia produce _____, a waste product that requires large amounts of water for removal. |
| _____ | 15. The paired excretory organs of the earthworm are called _____. |

PART **3**

Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

_____ 16. How does excretion function with regard to homeostasis?

- a) helps regulate body temperature
- b) helps cool the body
- c) removes wastes and regulates internal salt/water balance
- d) breaks down ingested poisons and drugs

_____ 17. Which of the following is NOT a by-product resulting from the breakdown of food molecules for the release of energy?

- a) nitrogenous wastes b) water c) carbon dioxide d) glucose

_____ 18. Salmon live in fresh water during part of their lives and in salt water for the remaining time. Which statement is TRUE?

- a) In salt water, salmon have a mechanism to eliminate excess salt.
- b) In fresh water, salmon tend to dehydrate.
- c) In salt water, salmon will retain as much salt as possible.
- d) In salt water, salmon tend to take in more water.

_____ 19. If you had to survive in the desert for a year, with an unlimited supply of food but a limited supply of water, what food(s) would you avoid and why?

- a) proteins, because nitrogenous wastes require water for elimination
- b) fats, because they require large amounts of water for digestion
- c) salt-free foods, because water will not be retained
- d) distilled water, because more water will leave the cells

_____ 20. What is the first step of excretion in complex animals?

- a) The excretory organs remove wastes from the blood.
- b) Wastes are picked up by blood and transported.
- c) Wastes are eliminated from the body.
- d) Wastes leave individual cells.

_____ 21. Which process produces water rather than excretes it?

- a) perspiring b) egestion c) cellular respiration d) exhalation

_____ 22. Which of the following organisms transports wastes through excretory organs?

- a) hydra b) grasshopper c) paramecium d) bean plant

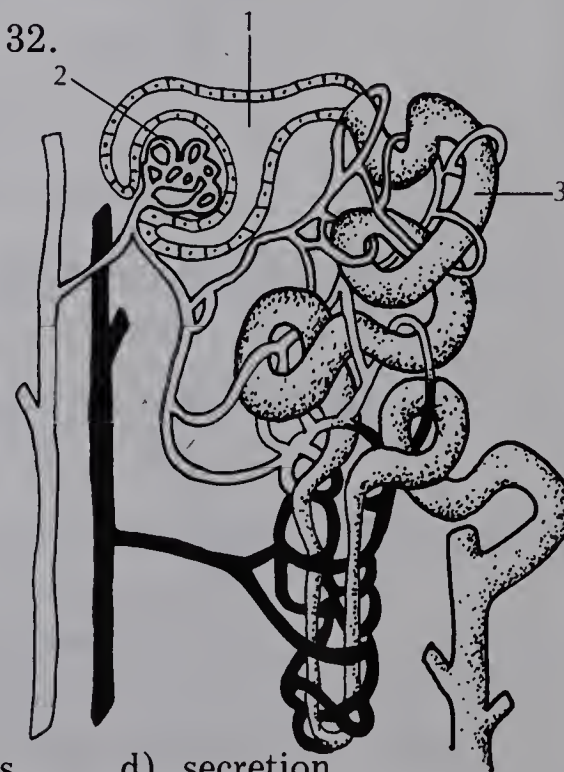
_____ 23. Which statement concerning excretion in plants is FALSE?

- a) Excess water leaves a plant through its roots.
- b) Plants do not normally produce any nitrogenous wastes.
- c) Much of the waste product CO_2 is used in photosynthesis.
- d) Some wastes are stored within vacuoles in plant cells.

- _____ 24. Which statement does NOT describe an excretory function in humans?
- Salts are removed by sweat glands.
 - Evaporating perspiration helps cool the body.
 - Hemoglobin is broken down in the liver.
 - The lungs remove carbon dioxide.
- _____ 25. In what way are the earthworm's nephridia similar to human nephrons?
- Both structures filter wastes out of the blood.
 - Both structures have a glomerulus and tubules.
 - Both help maintain a water balance in the organism.
 - Filtration is the main function of both structures.
- _____ 26. The liver serves as an excretory organ by:
- breaking down poisons and drugs.
 - filtering urea from the blood.
 - producing bile.
 - releasing iron from hemoglobin.
- _____ 27. The path of the urine which leaves a kidney would be:
- kidney → urinary bladder → ureter → urethra
 - kidney → renal vein → urinary system
 - kidney → ureter → urinary bladder → urethra
 - kidney → collecting tubule → bladder → ureter
- _____ 28. The hormone ADH functions in chemical control of the excretory system by:
- stimulating reabsorption of glucose and amino acids by kidney tubules.
 - stimulating kidney tubule cells to become more permeable to water.
 - regulating the amount of urea produced by the liver.
 - regulating the amount of water in the blood.

Refer to the diagram of a nephron to answer questions 29 through 32.

- _____ 29. Name structure 2.
- Bowman's capsule
 - renal artery
 - collecting tubule
 - glomerulus
- _____ 30. What enters structure 1?
- urea and water
 - renal vein
 - whole blood
 - plasma
- _____ 31. What process occurs in structure 3?
- reabsorption
 - urea formation
 - secretion of water
 - filtration
- _____ 32. The process of moving fluids from structure 2 to structure 1 is by:
- diffusion
 - filtration
 - osmosis
 - secretion



CHAPTER 11 Movement and Locomotion

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|---|------------------|
| _____ 1. single muscle cell | a) chitin |
| _____ 2. connects bone to bone | b) collagen |
| _____ 3. a projection of moving cytoplasm | c) muscle fiber |
| _____ 4. movement of an organism from place to place | d) filament |
| _____ 5. contraction and relaxation of a muscle fiber | e) flagella |
| _____ 6. complex carbohydrate contained in an exoskeleton | f) joint |
| _____ 7. process of shedding the outer covering of an organism's body | g) ligament |
| _____ 8. place where two bones come together | h) locomotion |
| _____ 9. bristles that aid in earthworm movement | i) matrix |
| _____ 10. firm, flexible material surrounding cartilage cells | j) molting |
| | k) pseudopod |
| | l) setae |
| | m) smooth muscle |
| | n) tendon |
| | o) twitch |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

actin	collagen	fatigue
appendages	elastin	involuntary
atrophy	endoskeleton	myosin
backbone	exoskeleton	voluntary

- _____ 11. Muscle at occurs when a muscle is not used.
- _____ 12. The two proteins involved in muscle contraction are _____ and actin.
- _____ 13. Insects have an exoskeleton, which means that their skeleton is external to their soft body parts.
- _____ 14. Long bones able to support weight are found in the axial of the human skeleton.
- _____ 15. Smooth muscle can be consciously controlled or caused to contract.

PART 3

Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. Which is NOT a possible function of locomotion in organisms?
 - a) finding food
 - b) escaping predators
 - c) digesting food
 - d) migrating to a new location
- _____ 17. What category of movement is involved when planaria contract their cilia?
 - a) movement within cells
 - b) movement of body parts
 - c) locomotion
 - d) migration
- _____ 18. What are turgor movements?
 - a) movements of a plant due to changes in water content of some cells
 - b) movement of an animal caused by simultaneous muscle fiber contractions
 - c) movements of a plant as it grows
 - d) movements of an ameba as it changes shape
- _____ 19. A muscle is taken from a frog's leg and is supplied with adequate ATP and an electrical impulse (which is similar to a nervous impulse). Yet the muscle will not contract. What factor necessary for muscle contraction must be missing?
 - a) ATP
 - b) microtubules
 - c) contractile filaments
 - d) calcium
- _____ 20. How does a skeleton aid the process of locomotion?
 - a) It provides a rigid framework against which muscles can pull.
 - b) It protects the internal body organs.
 - c) It generates nerve impulses to move skeletal muscles.
 - d) It gives shape to the body.
- _____ 21. When the hydra moves its body it does so by contracting:
 - a) muscles fibers.
 - b) specialized nerve cells.
 - c) contractile fibers.
 - d) its tentacles.
- _____ 22. What is the function of the longitudinal muscles in the earthworm?
 - a) They anchor the earthworm to its burrow.
 - b) By contracting, they push the earthworm's body forward.
 - c) They move the earthworm's skeleton forward.
 - d) By contracting, they cause the body to shorten.
- _____ 23. Which statement about locomotion in the grasshopper is FALSE?
 - a) Circular muscles enable the grasshopper to move its jaws.
 - b) Muscles in the thorax move the wings.
 - c) Muscles are responsible for its many types of locomotion.
 - d) The rear legs have well-developed muscles for jumping.

24. Which characteristic do bone cells and cartilage cells have in common?

- a) Both are surrounded by a matrix composed of polysaccharides.
- b) Both types of cells are surrounded by a nonliving matrix.
- c) Both are imbedded in a matrix that is flexible.
- d) Both types of cells are found in exoskeletons.

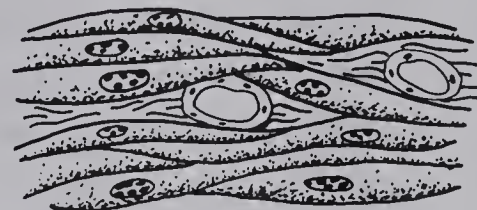
25. In the diagram the muscle connecting the two bones is in a relaxed state. What type of muscle is this?

- a) a flexor
- b) involuntary
- c) an extensor
- d) smooth



26. Which type of muscle cells are shown in the sketch?

- a) skeletal
- b) smooth
- c) voluntary
- d) cardiac



27. What is the function of cardiac muscle?

- a) controls voluntary movements
- b) pumps blood
- c) regulates the size of the pupil in the eye
- d) controls movement of many internal organs

28. What is the central idea of the sliding filament theory of muscle contraction?

- a) Nerve impulses cause the muscles to contract.
- b) During muscle contraction, actin and myosin filaments slide past one another.
- c) Muscle contraction is due to muscle fibers sliding past one another.
- d) During muscle contraction, the filaments get shorter.

29. Smooth muscle contraction differs from skeletal muscle contraction in that it:

- a) is slower and lasts longer.
- b) does not require ATP.
- c) is faster and lasts a shorter time.
- d) does not involve sliding filaments.

30. What substance accumulates in muscle cells during muscle fatigue?

- a) oxygen
- b) ATP
- c) glycogen
- d) lactic acid

31. How is the control of cardiac muscle contraction unique?

- a) It is not affected by the action of hormones.
- b) Cardiac muscle can create its own contractions.
- c) Only nervous control is involved.
- d) It is controlled by adrenalin.

CHAPTER 12 Chemical Control

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left. In this exercise you will be matching human hormones (right) and their specific functions (left).

- | | |
|---|---------------------------------------|
| _____ 1. causes the uterus lining to thicken during one stage of the female menstrual cycle | a) antidiuretic hormone (ADH) |
| _____ 2. stimulates the development of secondary sex characteristics in males | b) estrogen |
| _____ 3. causes glycogen in the liver and muscles to be converted to glucose | c) follicle stimulating hormone (FSH) |
| _____ 4. stimulates secretion of digestive enzymes | d) gastrin |
| _____ 5. regulates the rate of metabolism | e) glucagon |
| _____ 6. stimulates the absorption of water in the kidneys | f) growth hormone (GH) |
| _____ 7. stimulates skeletal growth | g) insulin |
| _____ 8. stimulates the production of thyroxine | h) luteinizing hormone (LH) |
| _____ 9. increases the amount of calcium in the blood | i) oxytocin |
| _____ 10. enables glucose to enter cells | j) parathyroid hormone (PTH) |
| | k) progesterone |
| | l) secretin |
| | m) testosterone |
| | n) thyroid stimulating hormone (TSH) |
| | o) thyroxine |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

auxins	endocrine	menstruation	ovulation
cytokinins	goiter	hypoglycemia	steroid
diabetes mellitus	hyperthyroidism	insulin	tetany

- | | |
|-------|---|
| _____ | 11. Cell division in plants is stimulated by a type of growth hormone known as _____. |
| _____ | 12. _____ glands secrete hormones directly into the bloodstream. |
| _____ | 13. The physical condition caused by an insufficient amount of insulin is _____. |
| _____ | 14. Enlargement of the thyroid gland due to lack of iodine is called _____. |
| _____ | 15. During the menstrual cycle, _____ occurs in response to increased levels of estrogen and luteinizing hormone. |

PART **3** Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

_____ 16. Which statement concerning hormones is INCORRECT?

- a) Only certain cells in an organism produce hormones.
- b) All hormones enter the bloodstream through ducts.
- c) The "target" refers to the cells affected by a hormone.
- d) Hormones are chemicals that help regulate life processes.

_____ 17. Why is the shape of a hormone molecule important?

- a) The shape determines whether or not the hormone can enter all the cells.
- b) The substrate will not react with irregularly-shaped molecules.
- c) The blood can carry only molecules with a round shape.
- d) Receptor cells combine only with hormone molecules having the correct shape.

_____ 18. What can you deduce from the following diagram of a newly sprouted seedling?

- a) Light is coming from the left.
- b) Gibberellins are more concentrated on the right side of the shoot.
- c) Light is coming from directly overhead.
- d) Auxins are more concentrated on the left side of the shoot.



_____ 19. Suppose you have a very tall tree with ripe fruit near the top. A botanist friend of yours suggests spraying the top of the tree with a chemical known to cause fruit to fall off. The chemical is likely to be:

- a) cytokinins b) ethylene gas c) abscisic acid d) auxins

_____ 20. Synthetic plant hormones kill weeds by:

- a) stimulating extensive root growth.
- b) causing the leaves to fall off prematurely.
- c) stimulating overly rapid growth, causing the plants to die.
- d) lowering the plants' resistance to insects.

_____ 21. What is cyclic AMP?

- a) a protein hormone
- b) a molecule produced when a protein hormone and receptor molecule combine
- c) the molecule that stores energy in a cell
- d) a receptor molecule that combines with several hormones

_____ 22. Which statement regarding steroids is FALSE?

- a) Steroids combine with receptor molecules in the cell membrane.
- b) Gonadotropin is an example of a steroid hormone.
- c) Steroids are small enough to enter cells directly.
- d) Steroids are a type of lipid, which functions as a hormone.

- _____ 23. Which of the following is NOT an example of a chemical feedback mechanism?
- a) As the level of calcium in the blood drops, more parathyroid hormone is produced.
 - b) In the absence of juvenile hormone, an insect develops an adult exoskeleton.
 - c) At birth the pituitary begins producing growth hormone.
 - d) Thyroxin production involves the hypothalamus as well as the pituitary and thyroid glands.
- _____ 24. The process of molting in insects involves which hormone(s)?
- a) brain hormone
 - b) molting hormone
 - c) juvenile hormone
 - d) all three
- _____ 25. The stages of complete metamorphosis in insects are:
- a) egg, nymph, adult
 - b) egg, larva, pupa, adult
 - c) egg, nymph, pupa, adult
 - d) egg, caterpillar, adult
- _____ 26. Assume that a disease is transmitted by the adults of a species of biting flies. How could the adult flies be eliminated in one season without using pesticides?
- a) Apply molting hormone to the nesting areas of the adults.
 - b) Cause the flies to go through incomplete metamorphosis.
 - c) Spray the larvae's food source with juvenile hormone.
 - d) Spray the egg masses with brain hormone.
- _____ 27. Which gland produces several hormones that regulate the production of other hormones?
- a) pancreas
 - b) adrenal gland
 - c) thyroid gland
 - d) pituitary gland
- _____ 28. Name the endocrine gland that secretes progesterone:
- a) testes
 - b) corpus luteum
 - c) pituitary
 - d) ovary
- _____ 29. Which statement regarding hormonal activity in humans is FALSE?
- a) Some hormones coordinate actions of several body systems.
 - b) Insulin and glucagon have opposite effects.
 - c) Each body function can be regulated by one or two hormones.
 - d) Hormones are involved in growth, development, and reproduction.
- _____ 30. Realizing that at least five different hormones work together in coordinating muscle contraction, choose the process NOT involved in a single muscle twitch.
- a) Parathyroid hormone regulates the amount of calcium in the blood.
 - b) Adrenalin, glucagon, and insulin regulate the glucose level in the blood.
 - c) Cortisol helps maintain salt and water balance in the body.
 - d) Thyroxin regulates the rate of oxygen use by cells.

CHAPTER

15

Reproduction of Molecules and Cells

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- _____

1. sequence of three bases on messenger RNA that codes for one amino acid
- _____

2. threadlike structure made up of DNA and protein
- _____

3. stage of mitosis during which centromeres divide and chromatids begin to separate
- _____

4. structure along which chromatids pull apart
- _____

5. process by which DNA reproduces itself
- _____

6. stage of mitosis in which spindle fibers form
- _____

7. sequence of nitrogen bases in DNA which acts as a pattern during formation of mRNA
- _____

8. length of time a cell remains alive
- _____

9. process of joining amino acids together in a specific sequence coded for by DNA
- _____

10. transfer of characteristics from one generation to the next
- a)

anaphase
- b)

base pairing
- c)

chromosome
- d)

cytoplasmic division
- e)

double helix
- f)

genetic code
- g)

heredity
- h)

life span
- i)

metaphase
- j)

prophase
- k)

protein synthesis
- l)

replication
- m)

spindle
- n)

telophase
- o)

template

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

- adenine

cancer

cell plate

cytoplasmic division
- cytosine

double helix

guanine

meiosis
- mitosis

prophase

spindle

thymine
- _____

11. In DNA, the nitrogen base thymine always bonds with _____ , and cytosine always bonds with _____ .
- _____

12. When replication and division of chromosomes results in two nuclei, each having the same number of chromosomes as the parent nucleus, _____ has taken place.
- _____

13. Cell reproduction that is uncontrolled and disorganized is a characteristic of _____ .
- _____

14. The shape of the DNA molecule is known as a _____ .
- _____

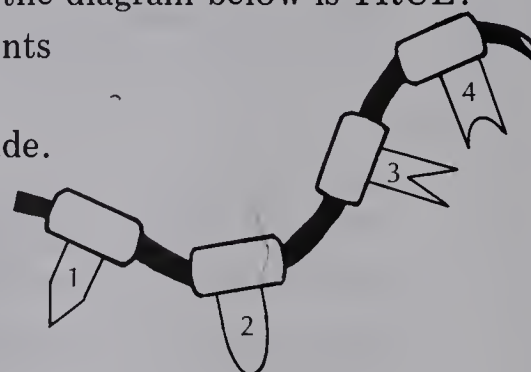
15. In the last stage of plant cell division the _____ begins to form.

PART 3

Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

_____ 16. Which of the following statements concerning the diagram below is TRUE?

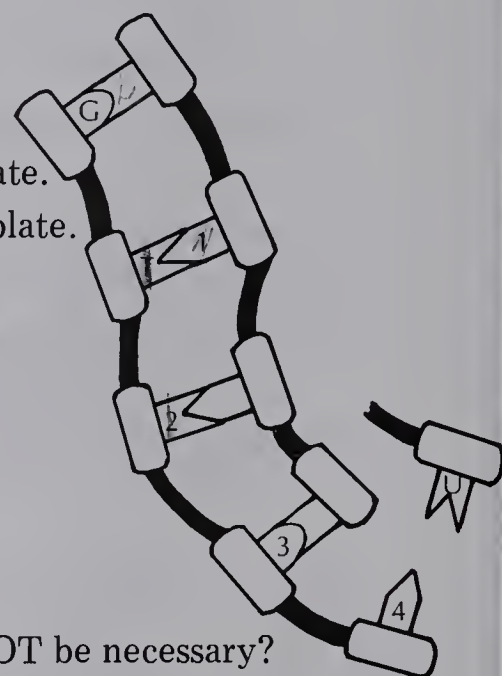
- Each of the four shapes (1, 2, 3, 4) represents a different nitrogen base.
- The entire diagram represents one nucleotide.
- The diagram shows a portion of a protein molecule being synthesized.
- The black circles represent deoxyribose sugar molecules.



Refer to the diagram to the right to answer questions 17 and 18.

_____ 17. What event is depicted in this diagram?

- DNA is being replicated.
- Transfer RNA is being formed from DNA template.
- Messenger RNA is being formed from DNA template.
- The molecule is in the process of unzipping.



_____ 18. Which is a TRUE statement?

- Numbers 2 and 4 represent the same base.
- Number 3 represents the base uracil.
- None of the numbers represent cytosine.
- Number 4 represents the base adenine.

_____ 19. In which case described below would cell division NOT be necessary?

- growth of a baby
- replacement of dead cells
- healing of a wound
- the synthesis of enzymes

_____ 20. If a biologist were to examine a small portion of your skin tissue under a microscope, which stage of cell division would most of the cells be in?

- telophase
- interphase
- prophase
- metaphase

_____ 21. Which of the following processes is NOT directly related to protein synthesis as coded for by DNA?

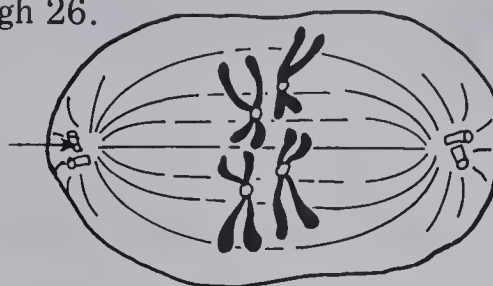
- building cell structures
- regulating chemical reactions in cells
- transmitting hereditary information from parents to offspring
- producing enzymes that control cell functions

_____ 22. In this diagram of a chromosome from a cell in late prophase, to what structure is the arrow pointing?

- centriole
- chromatid
- spindle
- centromere



Refer to the diagram of a cell to answer questions 23 through 26.



23. What phase of mitosis is diagramed?

- a) telophase c) metaphase
b) anaphase d) prophase

24. To what structure is the arrow pointing?

- a) spindle fiber b) centriole c) centromere d) cell plate

25. How many chromatids are present in the cell?

- a) 8 b) 16 c) 4 d) 0

26. How many pairs of homologous chromosomes are shown?

- a) none b) 2 c) 4 d) 8

27. Which of the following is NOT a difference between DNA and RNA?

- a) They are composed of different sugars.
b) They have one base that is different.
c) DNA is a nucleic acid; RNA is not.
d) One is single-stranded; the other is double-stranded.

28. The role of transfer RNA in protein synthesis is to:

- a) transport mRNA from the nucleus to cytoplasm.
b) attach mRNA to the ribosomes.
c) carry amino acids to the correct site on mRNA.
d) synthesize the ribosomes.

29. If the three bases on a section of tRNA carrying the amino acid valine are CAA, then the mRNA base sequence that codes for valine is:

- a) GUU b) CAA c) GTT d) TGG

30. How many DNA nucleotides would be involved in coding for a polypeptide chain twelve amino acids long?

- a) 4 b) 8 c) 12 d) 36

31. Refer to the chart to determine what amino acids would be joined if the sequence of bases on a strand of DNA were: T C G A A G A T G

- a) cysteine, lysine, lysine
b) methionine, lysine, serine
c) serine, lysine, methionine
d) cysteine, lysine, isoleucine

Base sequence on mRNA	Amino acid
AAG	lysine
AGC	serine
AUC	isoleucine
UAC	methionine
UGC	cysteine
UUC	lysine

CHAPTER 16 Reproduction of Organisms

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|--|--------------------|
| _____ 1. inheritable differences between members of the same species | a) clone |
| _____ 2. segment of a DNA molecule that codes for a specific protein | b) differentiation |
| _____ 3. type of cell division that reduces the number of chromosomes in the resulting cells | c) fertilization |
| _____ 4. fusion of a sperm and an egg | d) fragmentation |
| _____ 5. group of genetically identical offspring resulting from asexual reproduction of a single parent | e) gamete |
| _____ 6. female reproductive organ | f) gene |
| _____ 7. male reproductive organ | g) meiosis |
| _____ 8. fertilized egg | h) mitosis |
| _____ 9. reproductive cell involved in sexual reproduction | i) mutation |
| _____ 10. accidental change in a DNA molecule | j) ovary |
| | k) polar bodies |
| | l) spores |
| | m) testis |
| | n) variations |
| | o) zygote |

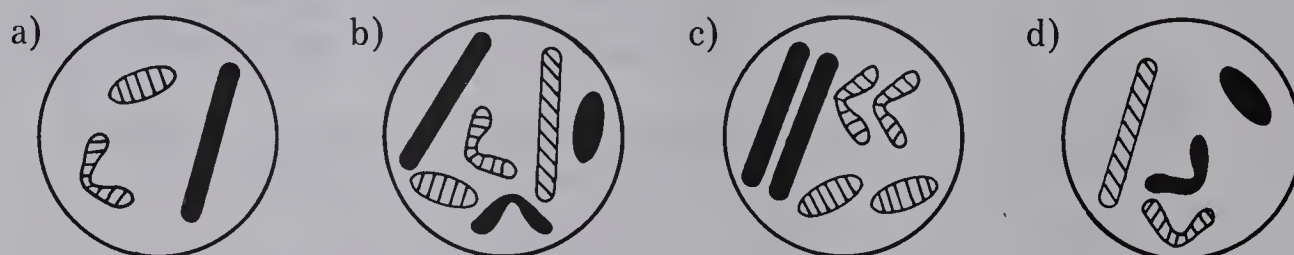
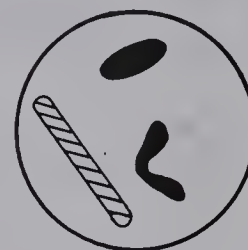
PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

asexual	haploid	sexual
budding	heterogametes	sperm
crossing over	isogametes	tetrad
diploid	ova	zygotes

- | | |
|-------|---|
| _____ | 11. _____ reproduction involves two parents, each contributing a reproductive cell to begin a new organism. |
| _____ | 12. A cell with the $2n$ number of chromosomes is said to be _____ |
| _____ | 13. A homologous pair of chromosomes forms a _____ during meiosis, consisting of four intertwined chromatids. |
| _____ | 14. In animals, male gametes are called _____. |
| _____ | 15. In sexual reproduction, reproductive cells that differ in size and shape are called _____. |

- PART **3** Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.
- _____ 16. The main difference between asexual and sexual reproduction is:
 a) Asexual reproduction involves only one parent.
 b) Asexual reproduction results in more variation among the offspring.
 c) Sexual reproduction is common only among simple organisms.
 d) Sexual reproduction results in a clone identical to the parents.
- _____ 17. Which of the following is an example of asexual reproduction?
 a) Isogametes of a green alga fuse to form a zygote.
 b) A lobster that loses a claw grows a new one.
 c) A piece of a potato develops into a new plant.
 d) Tapeworms develop from fertilized egg cells.
- _____ 18. An ameba divides to form two identical amebas. This is an example of:
 a) fertilization b) budding c) fragmentation d) binary fission
- _____ 19. In each cell of a moss plant that develops from a spore, the number of chromosomes is:
 a) the diploid number. c) less than the number in the spore cell.
 b) the haploid number. d) more than the number in the spore cell.
- _____ 20. Researchers have succeeded in growing new carrot plants from single mature cells of a parent carrot plant. What is NOT true about the new plants?
 a) They represent a clone.
 b) They are a result of asexual reproduction.
 c) They have exactly the same DNA as the parent plant.
 d) They will produce carrots with a wide variation in color and texture.
- _____ 21. In which of the following instances is a LACK of variation an advantage?
 a) a prize-winning rose plant being reproduced asexually to sell commercially
 b) a clone of wheat plants not resistant to a particular disease
 c) a group of genetically identical plants well-adapted to a particular set of environmental conditions, conditions which later change dramatically
 d) a high-yield variety of corn that is susceptible to insect attack
- _____ 22. If the haploid number of chromosomes for a particular species is 9, how many chromosomes are likely to be found in most of the organisms' cells?
 a) 3 b) 9 c) 18 d) 27
- _____ 23. Suppose a sexually reproducing organism possesses only one pair of chromosomes. If no recombination or crossing-over occurs, what are the chances that an offspring could inherit the gene that its father inherited from its father?
 a) 1 out of 2 b) 1 out of 4 c) 1 out of 8 d) 0

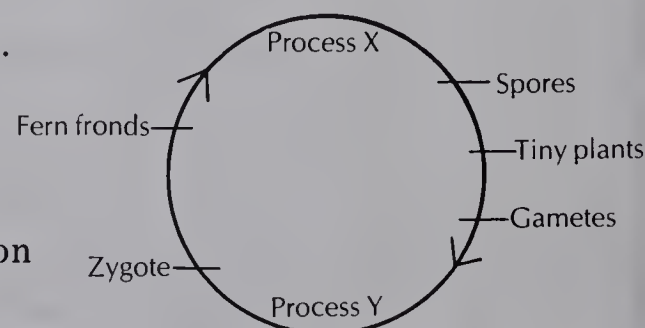
24. The diagram to the right shows a haploid gamete that resulted from meiosis of a diploid cell. Stripes denote chromosomes inherited maternally, solid represents paternal chromosomes. The shapes represent different chromosomes. If you assume no crossing over, which diagram below represents the diploid cell?



25. Which statement comparing meiosis and mitosis is TRUE?
- Mitosis and meiosis both take place in all cells of the body.
 - Meiosis involves only one cell division.
 - Mitosis results in two diploid daughter cells; meiosis results in four haploid cells.
 - Tetrads are formed in both mitosis and meiosis.
26. What one event in meiosis makes it possible for chromosomes in gametes to have NEW combinations of genes?
- formation of the spindle in Prophase I
 - crossing-over during synapsis
 - lining up of homologous chromosomes during Metaphase I
 - cytoplasmic division during Telophase II
27. The process of oogenesis normally takes place in:
- ovaries
 - polar bodies
 - ova
 - testes

28. The diagram represents the life cycle of a fern. What are processes X and Y?

- X = fertilization, Y = gametogenesis
- X = meiosis, Y = mitosis
- X = gametogenesis, Y = sexual reproduction
- X = meiosis, Y = fertilization



29. When frogs mate, the male grasps the female and deposits sperm on the eggs as the female releases them into the water. This is an example of:
- external fertilization
 - internal fertilization
 - spermatogenesis
 - parthenogenesis
30. During favorable conditions, female aphids lay unfertilized eggs which develop into female aphids. This is an example of:
- differentiation
 - spermatogenesis
 - fission
 - parthenogenesis

CHAPTER 17 Reproduction, Growth, and Development in Plants

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|---|-------------------------------|
| _____ 1. reproductive structure in angiosperms that often contains both male and female reproductive organs | a) alternation of generations |
| _____ 2. sweet substances produced by some plants to attract animal pollinators | b) cotyledon |
| _____ 3. plant life cycle, which includes a sexual stage and an asexual stage | c) cutting |
| _____ 4. wood composed of water-conducting xylem | d) flower |
| _____ 5. immature leaf that stores food in a seed | e) fruit |
| _____ 6. ripened or matured ovary of a flowering plant | f) heartwood |
| _____ 7. flower structure that contains the embryo sac before fertilization | g) nectar |
| _____ 8. runners on strawberry plants grow into new plants | h) ovule |
| _____ 9. piece of a plant stem that develops into a new plant | i) primary growth |
| _____ 10. lengthwise growth of stems and roots | j) sapwood |
| | k) secondary growth |
| | l) vegetative propagation |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

annual	calyx	lateral	pollen grain
anther	cork cambium	perennial	ray
apical	corolla	phloem	spore
biennial	filament	pistil	xylem

- _____ 11. A sepal is part of the _____ of a flower in the same way that a petal is part of the _____ .
- _____ 12. The male gametophyte in flowering plants is the _____ .
- _____ 13. The actively growing tissue at the tips of roots and shoots is called the _____ meristem.
- _____ 14. A plant that lives for several seasons is called a _____ .
- _____ 15. Bark is composed of three main tissues: cork, _____ , and _____ .

PART 3

Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. Which plant structure is NOT involved in vegetative propagation?
a) seed b) runner c) bulb d) stock
- _____ 17. An orchard owner grafted Bartlett pear scions to quince rootstock. Which statement concerning this grafting is FALSE?
a) It is an example of artificial vegetative propagation.
b) The trees will produce Bartlett variety pears.
c) The vascular cambiums of scion and stock must be in contact to ensure a successful graft.
d) The quince rootstock was selected for its ability to produce fruit.
- _____ 18. A gametophyte plant produces gametes by the process of:
a) spore formation b) meiosis c) mitosis d) fertilization
- _____ 19. Most cells of a corn plant contain 20 chromosomes. How many chromosomes would be found in a grain of corn pollen?
a) none b) 10 c) 20 d) 40
- _____ 20. Which is a correct sequence of events in a plant's life cycle?
a) spores → sporophyte → gametes → gametophyte
b) fertilization → zygote → gametophyte → meiosis
c) meiosis → gametes → fertilization → spores
d) sporophyte → meiosis → spores → gametophyte
- _____ 21. According to a newspaper report a new species of moss has been found in a dry, windy area in the Southwest. Is the report likely to be TRUE?
a) Yes, most gametophyte plants prefer dry conditions.
b) Yes, mosses are wind-pollinated.
c) No, mosses are pollinated by insects.
d) No, water must be present for sperm to swim to eggs.
- _____ 22. During the life cycle of a fern each gametophyte plant produces:
a) sporangia c) both sperm and eggs
b) either sperm or eggs d) a haploid sporophyte
- _____ 23. The gametophyte generation is smaller or less dominant in:
a) flowering plants b) ferns c) mosses d) green algae
- _____ 24. Which of the following is a MALE reproductive organ?
a) stigma b) pistil c) stamen d) ovary
- _____ 25. Which of the following is NOT a part of a seed?
a) seed coat b) embryo c) fruit d) cotyledons

- _____ 26. *Double fertilization*, found only in flowering plants, is a process in which:
- two female spores unite with two male spores.
 - two sperm unite with two different cells in the embryo sac.
 - the zygote unites with a second sperm cell.
 - the egg and an endosperm cell each unite with a sperm cell.
- _____ 27. Wheat plants are normally self-pollinating. Why, then, would a plant breeder want to artificially cross-pollinate wheat plants?
- to fertilize any eggs not fertilized from self-pollination
 - to keep the wheat plants genetically similar
 - to develop a new variety by combining genes of two different parents
 - to increase the amount of wheat berries (seeds) produced
- _____ 28. Which of the following statements concerning seeds is TRUE?
- There are very few adaptations for seed dispersal.
 - Seeds can remain dormant until conditions are favorable for germination.
 - Most of the space in a seed is filled by the embryo.
 - Seeds develop either male or female flowers.
- _____ 29. Successful germination of seeds does NOT require:
- oxygen
 - moisture
 - soil
 - proper temperature
- _____ 30. The sequence of events during sexual reproduction in a flowering plant is:
- seed germination, fertilization, maturation of ovules, pollination
 - fertilization, pollination, seed germination, maturation of ovules
 - pollination, fertilization, maturation of ovules, seed germination
 - maturation of ovules, pollination, fertilization, seed germination

Answer questions 31 through 33 by referring to the diagram of the cross section of a plant.

- _____ 31. In which labeled part(s) of the stem are the majority of cells dead?

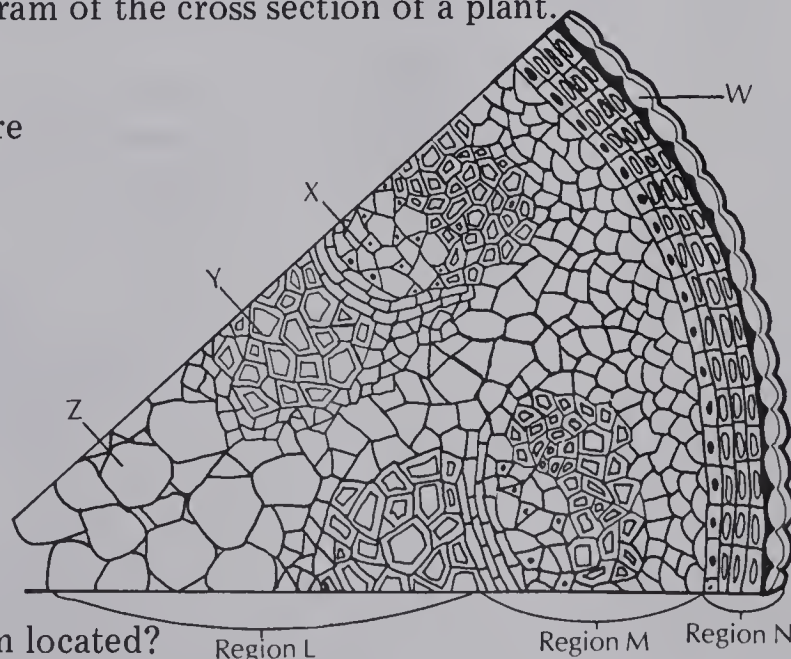
- W and Z
- W, X, and Z
- X and Y
- Z only

- _____ 32. How does structure Y function?

- conducts water up the tree
- carries food to the roots
- transports materials laterally
- indicates the age of the tree

- _____ 33. In what region is the vascular cambium located?

- region L
- region M
- region N
- none of the above



CHAPTER 18 Reproduction and Development in Vertebrates

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left. (All questions in this section refer to human reproduction.)

- | | |
|---|------------------------|
| _____ 1. physical process of childbirth | a) chorion |
| _____ 2. process of repeated cell division following fertilization of an egg | b) cleavage |
| _____ 3. male and female reproductive behavior | c) embryonic induction |
| _____ 4. fluid containing secretions and sperm | d) follicle |
| _____ 5. saclike structure in which an egg matures | e) gestation |
| _____ 6. process in which one tissue of an embryo contacts and affects the development of another tissue | f) gonad |
| _____ 7. sac surrounding the testes | g) labor |
| _____ 8. reproductive organ that produces gametes | h) mating |
| _____ 9. organ that develops within the uterus during pregnancy, composed of maternal and embryonic tissues | i) ovary |
| _____ 10. membrane surrounding the embryo that provides food in early development | j) placenta |
| | k) scrotum |
| | l) semen |
| | m) yolk sac |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

blastula
cleavage
embryo
estrus

fetus
gestation
morula
offspring

primitive streak
prostate
sperm
vas deferens

- | | |
|-------|---|
| _____ | 11. The path of sperm from their origin to outside the body is seminiferous tubule → _____ → urethra. |
| _____ | 12. Another term for pregnancy is _____. |
| _____ | 13. An early embryonic form consisting of three cell layers is the _____. |
| _____ | 14. After a developing human is eight weeks old it is called a(n) _____. |
| _____ | 15. Producing large numbers of _____ is an adaptation for survival. |

- PART **3** Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.
- _____ 16. Which of the following is NOT associated with puberty?
 a) Secondary sex characteristics develop. c) A male begins producing sperm.
 b) A female becomes able to bear children. d) A female begins menopause.
- _____ 17. Within the male gonads, cells that undergo meiosis and develop into sperm are found:
 a) within the scrotum. c) within the prostate gland.
 b) lining the seminiferous tubules. d) lining the vas deferens.
- _____ 18. Which description of differences between egg and sperm is FALSE?
 a) Sperm cells contain an extra pair of chromosomes in their nucleus.
 b) An egg is larger than a sperm cell.
 c) A male can produce millions of sperm at a time; a female usually develops only one egg at a time.
 d) All the cells that might undergo meiosis to form eggs are present at birth, but cells that become sperm are continuously being formed.
- _____ 19. Which is not a behavioral adaptation that helps synchronize gamete release in vertebrates?
 a) rutting b) courtship c) puberty d) estrus
- _____ 20. Which statement concerning fertilization is TRUE?
 a) The zygote implants in the womb the day after fertilization.
 b) In the case of fraternal twins, more than one sperm fertilizes an egg.
 c) After a sperm penetrates an egg, a membrane forms around the egg.
 d) The egg swims to meet the sperm.
- _____ 21. A human embryo develops into a hollow ball of cells:
 a) three days following fertilization. c) while still in the oviduct.
 b) that is actually made up of two cell layers. d) called a blastula.
- _____ 22. An embryologist studying the early development of the human brain should closely observe:
 a) the outer layer of cells, or ectoderm.
 b) the layer of cells that makes up the endoderm.
 c) the membranes surrounding the blastula.
 d) the development of mesoderm cells.
- _____ 23. The umbilical cord:
 a) carries the mother's blood to the embryo.
 b) is a part of the placenta.
 c) is filled with amniotic fluid.
 d) attaches the embryo to the placenta.

_____ 24. Which statement regarding the primitive streak is FALSE?

- a) It is a characteristic unique to mammals.
- b) It develops into the spinal cord.
- c) It develops within two weeks of an embryo's life.
- d) It is an outgrowth of ectoderm.

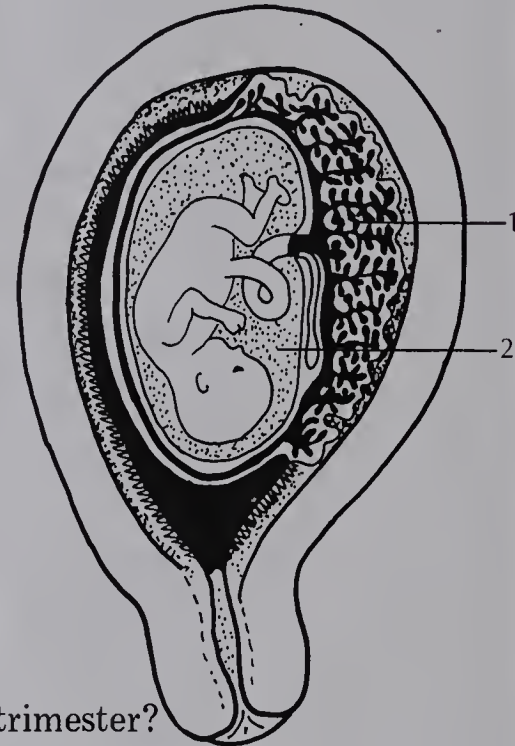
Answer the following two questions by referring to the diagram of a human uterus during pregnancy.

_____ 25. What is structure 1?

- a) yolk sac
- b) placenta
- c) amnion
- d) allantois

_____ 26. What is the function of the substance in area 2?

- a) supplies the embryo with oxygen
- b) exchanges substances by mixing maternal and fetal blood
- c) protects the embryo
- d) provides food for the embryo



_____ 27. Which of the following does NOT develop in the first trimester?

- a) heart b) overall body form c) bones d) facial features

_____ 28. Which system in the baby's body is fully functioning BEFORE birth?

- a) respiratory b) circulatory c) digestive d) excretory

_____ 29. Which statement about the birth process is FALSE?

- a) The cervix must dilate before the baby can move out of the uterus.
- b) The baby leaves the mother's body through the vagina.
- c) The afterbirth contains tissues and fluids that surrounded and nourished the fetus.
- d) The baby is pushed out by muscular contractions of the cervix and birth canal.

_____ 30. What structure of bird and reptile eggs is an adaptation that allows the embryos to survive on dry land?

- a) shell b) yolk c) allantois d) amnion

_____ 31. Which statement does NOT describe a pattern of reproduction and development found in vertebrates?

- a) external fertilization in water; embryo nourished by yolk
- b) external fertilization; embryo nourished through a placenta
- c) internal fertilization; embryo develops inside the mother
- d) internal fertilization; embryo develops in an egg on land

CHAPTER **21** Change Over Time

PART **1** Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|---|----------------------------|
| _____ 1. non-functioning body part still present in a species | a) abiogenesis |
| _____ 2. method for dating organic fossils younger than 50 000 years | b) acquired characteristic |
| _____ 3. method for determining the age of rock surrounding a fossil | c) active principle |
| _____ 4. layer of rock particles deposited by water | d) biogenesis |
| _____ 5. idea that living things arise from nonliving things under certain conditions | e) carbon-dating method |
| _____ 6. preserved remains or traces of an organism | f) extinction |
| _____ 7. Aristotle's name for the one difference between living and nonliving matter | g) fossil |
| _____ 8. <i>The Origin of Species</i> presented this theory | h) heterotroph hypothesis |
| _____ 9. physical change in an organism that appears during its lifetime | i) homologous structure |
| _____ 10. the permanent disappearance of a species | j) natural selection |
| | k) ozone layer |
| | l) potassium-argon method |
| | m) sediment |
| | n) sedimentary rock |
| | o) vestigial organ |

PART **2** Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

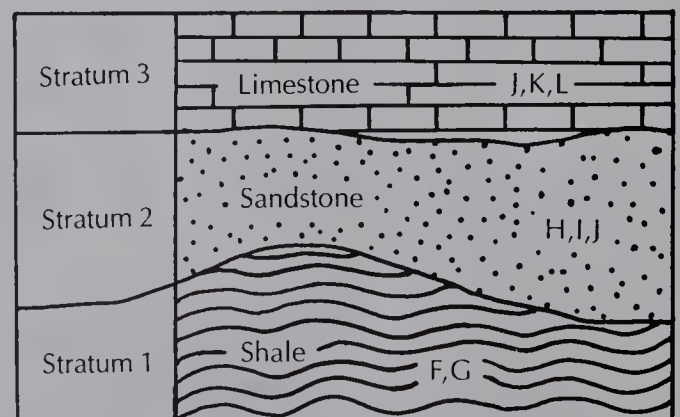
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|-------------|------------|-------------|---------|
| abiogenesis | biogenesis | heterotroph | Oparin |
| Aristotle | Darwin | Lamarck | Redi |
| autotroph | Fox | Miller | Wallace |

- _____ 11. An organism that cannot produce its own food is called a(n) _____ .
- _____ 12. To disprove the theory of _____ , Pasteur designed a special piece of equipment, the swan-neck flask.
- _____ 13. The two men who formulated the idea of natural selection as the key to understanding how species change over time were _____ and _____ .
- _____ 14. _____ proposed that physical changes acquired by an organism in its lifetime could be inherited.
- _____ 15. _____'s experiments with clumping of polypeptides lent support to the heterotroph hypothesis.

PART 3

Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. What did Redi conclude from his experiments?
- Flies develop from meat in the presence of air alone.
 - Maggots come from flies, not from rotting meat.
 - Maggots come from screens.
 - Abiogenesis had occurred.
- _____ 17. Which of the following was NOT an important part of Pasteur's experiment?
- The flasks containing broth were boiled for several hours.
 - One flask had a curved neck.
 - Bacteria were introduced by Pasteur into the broth before boiling it.
 - A control group of flasks without curved necks was used.
- _____ 18. The primitive atmosphere is thought to have been composed of all of the following EXCEPT:
- carbon dioxide
 - hydrogen
 - ammonia
 - oxygen
- _____ 19. According to Oparin's hypothesis, the first simple forms of life were:
- heterotrophs.
 - autotrophs.
 - formed in the atmosphere of early earth.
 - formed from clumps of inorganic molecules.
- _____ 20. What can be concluded from the results of the experiment performed by Miller and Urey?
- Organic molecules can be synthesized in outer space.
 - Cells can be formed from amino acids and sugars.
 - It may have been possible for organic molecules to be produced in the earth's primitive conditions.
 - Organic molecules were originally synthesized in sea water.
- _____ 21. The diagram shows an undisturbed cross section of rock layers. The letters represent fossil species found in each layer of rock. Note that the layers are different types of rock and their thicknesses are not equal. Which statement about this cross section is TRUE?
- Stratum 3 is thinnest because sediment was laid down at a faster rate.
 - Fossils K and L are younger than fossil species H and I.
 - The thicker the layer of rock, the older the fossils in that layer.
 - Fossils F and G are the youngest species in this cross section.



- _____ 22. According to the fossil record, which were the earliest inhabitants of earth?
- a) dinosaurs
 - b) complex invertebrates
 - c) trilobites
 - d) blue-green algae
- _____ 23. Suppose you want to determine the relationship between two species. You note that they have homologous structures, four-chambered hearts, and similar hemoglobin molecules. What additional shared characteristic is MOST convincing for believing that the species are closely related?
- a) live in the same habitat
 - b) same body size
 - c) similar enzymes and hormones
 - d) similar digestive systems
- _____ 24. The Kaibab squirrel lives on the North Rim of the Grand Canyon. This squirrel can, but rarely does, interbreed with the Abert squirrel on the South Rim of the Canyon. Which statement is FALSE?
- a) The two species of squirrels may have developed from the same ancestral species.
 - b) The two types of squirrels represent two distinct unrelated species.
 - c) The two types of squirrels are probably closely related species.
 - d) The Grand Canyon serves as a barrier to separate the two types of squirrels.
- _____ 25. Which of the following is an example of natural selection?
- a) As the earth's climate became colder, woolly mammoths adapted by growing thicker coats of fur.
 - b) When the (food supply grew scarce), giraffes developed longer necks to reach the higher leaves on trees.
 - c) Even though Weismann cut off the tails of mice, succeeding generations of mice were born with tails.
 - d) Penicillin was introduced into a bacteria culture. The most resistant bacteria survived and produced offspring resistant to penicillin.
- _____ 26. Which statement is part of Darwin's theory of natural selection?
- a) Natural selection causes variations to occur in species.
 - b) Acquired traits are inherited based on use and disuse.
 - c) Competition between organisms occurs due to limited resources.
 - d) Variations between organisms are quite rare, and thus significant.
- _____ 27. Consider the case of natural selection acting on the peppered moth in industrial England. As pollution increased so did the numbers of black moths in relation to light-colored moths. How do you explain the origin of the black moths?
- a) As the trees darkened, light-colored moths adapted by becoming darker.
 - b) The black moths were there but didn't show up on the lighter trees.
 - c) Because the black moths were better adapted to the polluted air, they increased in number.
 - d) The peppered moth species has always included a variety that is dark colored.

CHAPTER 22 Interactions in the Ecosystem

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|--|-----------------------|
| _____ 1. an organism that breaks down materials in dead organisms and waste products of living organisms | a) commensalism |
| _____ 2. water that falls from the atmosphere to the earth | b) condensation |
| _____ 3. change of water from a vapor to a liquid | c) decomposer |
| _____ 4. an organism that obtains food from a living organism while living on or inside the organism | d) evaporation |
| _____ 5. diagram of feeding relationships in an ecosystem | e) food chain |
| _____ 6. an organism that can produce its own food | f) food web |
| _____ 7. an organism that eats producer organisms | g) mutualism |
| _____ 8. process by which bacteria change nitrogen gas into nitrates | h) nitrogen fixation |
| _____ 9. relationship that involves interaction between two species of organisms | i) parasite |
| _____ 10. relationship between two organisms in which one benefits and the other is unaffected | j) precipitation |
| | k) primary consumer |
| | l) producer |
| | m) scavenger |
| | n) secondary consumer |
| | o) symbiosis |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

carbon dioxide	heat	predator
chemical energy	herbivore	producer
fertilizers	omnivore	proteins
glucose	oxygen	scavenger

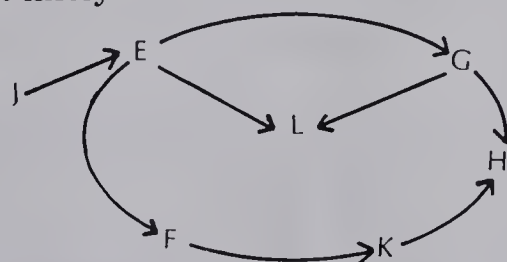
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|-------|--|
| _____ | 11. A consumer that eats dead animals it did not kill is a(n) _____. |
| _____ | 12. A(n) _____, such as a raccoon, eats both plants and animals. |
| _____ | 13. The energy lost in food chains is usually in the form of _____. |
| _____ | 14. Nitrogen is important in living things because it is necessary for the formation of _____. |
| _____ | 15. The burning of fossil fuels returns _____ to the environment. |

PART 3 Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. If the following were arranged into a food chain, which group would be the final consumer?
a) herbivores b) scavengers c) producers d) primary consumers
- _____ 17. Observations of antelope indicate that their diet consists entirely of plants. The antelope is a(n):
a) producer b) herbivore c) decomposer d) omnivore
- _____ 18. If all bacteria on earth were eliminated, all other living things would die off. Why?
a) Without decomposing bacteria, nutrients in dead organisms would not be recycled.
b) Bacteria are at the beginning of every food chain.
c) Bacteria are responsible for returning oxygen to the atmosphere.
d) Bacteria are important producers.
- _____ 19. Below is a diagram of a food chain found in a river ecosystem. Which of the following statements regarding this food chain is FALSE?
algae → crustaceans → minnows → large fish
a) The chain represents feeding relationships and the path of energy transfer.
b) Crustaceans are the primary consumers.
c) Crustaceans and large fish are secondary consumers.
d) It includes one type of herbivore and two types of carnivore.

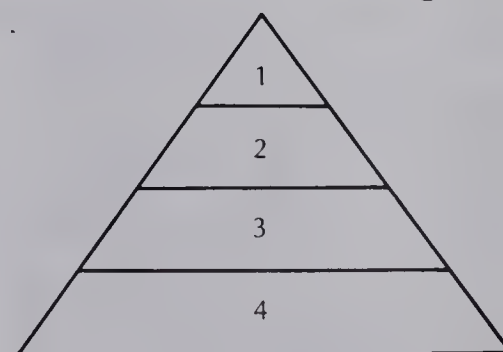
- _____ 20. The food web diagrammed represents organisms in feeding relationships. Which letter most likely represents a producer?

- a) J
b) E
c) K
d) L



- _____ 21. Referring to the diagram of an energy pyramid, which statement concerning level 4 is FALSE?

- a) It represents individual organisms that are smaller than those in level 3.
b) The amount of available energy in level 4 is greater than in level 1.
c) There are fewer organisms but more available energy in level 4 than in level 3.
d) Carnivores would not be found in level 4.



- _____ 22. What is the fate of ingested food that undergoes cellular respiration?
- a) It will never be used to provide energy for the organism.
 - b) This food leaves the organism as undigested material.
 - c) It provides energy for cell functions.
 - d) This food supplies materials to build and repair body parts.
- _____ 23. Which is the correct sequence of events in the water cycle in an ecosystem?
- a) precipitation → evaporation → condensation → precipitation
 - b) evaporation → precipitation → condensation → evaporation
 - c) precipitation → condensation → evaporation → precipitation
 - d) condensation → evaporation → precipitation → condensation
- _____ 24. For a plant to use nitrogen, what form must it be in?
- a) nitrites b) nitrogen gas c) nitrates d) ammonia
- _____ 25. List the successive forms of nitrogen in the nitrification process.
- a) ammonia, nitrites, nitrates
 - b) nitrates, protein, ammonia
 - c) protein, ammonia, nitrates
 - d) fertilizer, plants, ammonia
- _____ 26. Which of the following REMOVES nitrates from the soil in a farm ecosystem?
- a) alfalfa plants
 - b) fertilizers
 - c) nitrogen-fixing bacteria
 - d) denitrifying bacteria
- _____ 27. Flowers supply nectar as food for insects that in turn pollinate flowers they visit. What type of symbiosis exists between insects and flowers?
- a) commensalism b) mutualism c) parasitism d) competition
- _____ 28. Pneumonia bacteria find food and shelter in the human body they infect. The relationship between pneumonia bacteria and humans is one of:
- a) parasite-host b) commensals c) scavenger-prey d) predator-prey
- _____ 29. In Australia, rabbits and the small, bearlike wombats eat the same kinds of grasses. Their relationship is one of:
- a) competition b) mutualism c) commensalism d) parasitism
- _____ 30. Which statement does NOT describe a predator-prey relationship?
- a) The prey animal serves as food for the predator animal.
 - b) In a balanced predator-prey relationship the prey benefits as a population.
 - c) Predator and prey are involved in a commensal interaction.
 - d) Predators act to control the number of individuals in a prey population.

CHAPTER 25 Behavior

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|--|---------------------|
| _____ 1. population whose members perform specialized functions | a) anthropomorphism |
| _____ 2. a change in behavior that is based on experience | b) biological clock |
| _____ 3. group of individuals that performs certain tasks within a colony | c) caste |
| _____ 4. substance that transforms developing honeybee larvae into queens | d) circadian rhythm |
| _____ 5. attributing human emotions to other animals | e) diurnal cycle |
| _____ 6. behavior that involves movements directly toward or away from a stimulus | f) instinct |
| _____ 7. natural, day-night cycle | g) kinesis |
| _____ 8. movement of organisms from one region to another and then back to the original location | h) learning |
| _____ 9. ability to store and later recall information | i) memory |
| _____ 10. a sort of internal timer for biological cycles | j) migration |
| | k) queen substance |
| | l) reasoning |
| | m) royal jelly |
| | n) society |
| | o) taxis |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

colony	kinesis	releaser
conditioned response	long-day	short-day
grooming cluster	pecking order	territory
instinct	reinforcer	troop

- | | |
|-------|---|
| _____ | 11. In a learning situation, a reflex action given in response to a new stimulus is known as a(n) _____ . |
| _____ | 12. An external stimulus that brings about an inborn response is called a(n) _____ . |
| _____ | 13. Plants that require a long uninterrupted period of darkness in order to flower are called _____ plants. |
| _____ | 14. A _____ consists of a small group of baboons that clean and pick insects off one another. |
| _____ | 15. When chickens establish a _____ they are exhibiting social dominance behavior. |

PART 3

Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. Which of the following should NOT be classified as an example of behavior?
- a) A dog runs toward its owner when its name is called.
 - b) Smooth muscles contract to push food through the digestive tract.
 - c) A plant grows toward sunlight.
 - d) When a male blackbird sings, other male blackbirds stay out of his territory.
- _____ 17. When ants die they release a chemical that causes other ants to carry the dead ant out of the nest. When the same chemical is painted on a living ant the other ants respond as if it were a dead ant. Their behavior is an example of:
- a) learned behavior
 - b) tropism
 - c) stereotyped behavior
 - d) reasoning
- _____ 18. What is the difference between a tropism and a taxis?
- a) A tropism involves movement toward a stimulus; a taxis, movement away from a stimulus.
 - b) A tropism is a type of unlearned behavior; a taxis is a type of learned behavior.
 - c) A taxis is a type of kinesis, while a tropism is not.
 - d) A tropism is a behavior found in plants; a taxis is a behavior found in organisms capable of locomotion.
- _____ 19. Occasionally, cowbirds lay eggs in a kinglet's nest with the result that the kinglet does the work of raising the cowbird's offspring. This is a situation in which:
- a) the kinglet responds to visual stimuli.
 - b) the kinglet's instinct to raise young operates regardless of whether they are its own offspring.
 - c) cowbird eggs do not act as releasers of maternal behavior in the kinglet.
 - d) aggressive behavior is directed toward intruders by the kinglet.
- _____ 20. The female stickleback fish will not spawn until the male prods her tail. This action by the male stickleback acts as a:
- a) reflex
 - b) conditioned response
 - c) releaser
 - d) pheromone
- _____ 21. In order to teach a hunting dog not to react to the noise of a gun, a person fired the gun many times in the dog's presence. Eventually, the dog showed no real response to gunfire. The dog had learned not to respond by means of:
- a) imprinting
 - b) operant conditioning
 - c) short-term memory
 - d) habituation
- _____ 22. The scientist who experimented with and first described imprinting was:
- a) Konrad Lorenz
 - b) B. F. Skinner
 - c) Ivan Pavlov
 - d) N. Tinbergen

- _____ 23. If a student writes a composition for English class and the teacher gives the student an "A" and much praise, the student will be more likely to want to write more compositions. This is an example of:
- a) negative reinforcement.
 - b) operant conditioning.
 - c) reasoning.
 - d) classical conditioning.
- _____ 24. Which is NOT a characteristic of reasoning?
- a) Reasoning behavior is based on intelligence.
 - b) Learning by reasoning involves using memory.
 - c) Reasoning behavior depends on rewards or punishments.
 - d) A reasoned response involves using information from past experiences.
- _____ 25. Two experimenters planted soybeans at two-week intervals from early May through July. All the plants flowered at the same time in September. This shows:
- a) soybeans are day-neutral plants.
 - b) flowering in soybeans is determined by the age of the plant.
 - c) flowering in soybeans requires lower temperature.
 - d) soybeans require a certain length of darkness to flower.
- _____ 26. Salmon whose nasal passages were blocked with cotton were unable to locate the stream in which they were hatched. This supports the idea that a crucial factor in salmon migration is:
- a) sense of smell.
 - b) imprinting.
 - c) positive tropism.
 - d) ability to reason.
- _____ 27. Male mosquitoes are attracted to tuning forks that emit a sound at the same pitch as the sound a female mosquito produces in flight. In this case, sound communication is important:
- a) for warning other members of the species.
 - b) for frightening predators.
 - c) for establishing territories.
 - d) for locating mates.
- _____ 28. Which statement about a honeybee colony is FALSE?
- a) The males develop from unfertilized eggs.
 - b) Worker bees and queen bees are diploid females.
 - c) The worker bees produce wax to build cells of the hive.
 - d) Bee dances indicating food sources are a type of chemical communication.
- _____ 29. Which is NOT a function of territoriality?
- a) reduces aggression
 - b) helps animals cooperate in chasing away predators
 - c) lessens the amount of competition between animals of the same species
 - d) tends to distribute organisms throughout an area
- _____ 30. What characteristic of human social behavior makes it difficult to apply information about social behavior of animals to humans?
- a) It involves conscious choices
 - b) It depends largely on heredity.
 - c) It depends on conditioning.
 - d) It involves learning.

CHAPTER 26 Health and Disease

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|--|------------------------|
| _____ 1. chemical substance produced by the body to fight foreign substances | a) alcoholism |
| _____ 2. a weakened or dead pathogen introduced into the body to cause immunity to a disease | b) antibody |
| _____ 3. medical treatment that utilizes drugs | c) antigen |
| _____ 4. the idea that microorganisms are responsible for diseases | d) bacteriophage |
| _____ 5. responses of a drug addict's body when the drug is discontinued | e) carcinogen |
| _____ 6. chemical substance used to treat illness | f) chemotherapy |
| _____ 7. chemical substance that causes cancer | g) drug |
| _____ 8. study of diseases of populations | h) epidemiology |
| _____ 9. inflammation due to a reaction between an antibody and an antigen is an example | i) germ theory |
| _____ 10. type of white blood cell | j) immune reaction |
| | k) immunity |
| | l) lymphocyte |
| | m) toxin |
| | n) vaccine |
| | o) withdrawal sickness |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

active
antibiotic
barbiturate
caffeine

communicable
immune system
immunity
mind-altering

narcotic
nicotine
passive
vaccination

- _____ 11. In describing diseases, _____ is another word for contagious.
- _____ 12. _____ is a drug found in cigarettes.
- _____ 13. The physical state of being able to resist a particular disease is called _____.
- _____ 14. A treatment in which antibodies are injected into a person to provide protection against a disease is termed _____ immunity.
- _____ 15. Because marijuana and LSD change a person's perceptions, they are called _____ drugs.

PART 3 Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. Anemia is caused by a lack of hemoglobin in the red blood cells. Sometimes a lack of iron in the diet can cause anemia since iron is necessary to synthesize hemoglobin. In this case, the cause of anemia would be classified as:
- a) an environmental factor. c) a malfunction of body parts.
b) a hereditary disorder. d) an infectious organism.
- _____ 17. Is pollution related to disease?
- a) No, pollution has nothing to do with disease.
b) Yes, pollution may lessen a person's immunity to disease.
c) Yes, chemical pollution can cause disease.
d) No, pollution is only related to the quality of the environment.
- _____ 18. Which of the following diseases has NOT been shown to occur more frequently among smokers?
- a) lung cancer b) emphysema c) stomach ulcers d) cystic fibrosis
- _____ 19. The statement about alcohol that is FALSE is that alcohol:
- a) does not affect a person's judgment. c) can cause damage to the liver.
b) increases heart rate. d) is a depressant of the nervous system.
- _____ 20. Which of the following is TRUE?
- a) An alcoholic's dependence on alcohol is psychological and not physical.
b) Often an alcoholic has a difficult time maintaining good job performance.
c) A person who drinks wine or beer cannot become an alcoholic.
d) An alcoholic can stop drinking with no serious side-effects.
- _____ 21. Which statement concerning drugs is TRUE?
- a) Drugs used to induce sleep are called amphetamines.
b) Drugs that change perceptions and feelings are called barbiturates.
c) Drugs can cause physical addiction if used repeatedly.
d) Drugs are never abused by people who begin taking them as medical treatment.
- _____ 22. Which pairing of a disease and its manner of transmission is INCORRECT?
- a) athlete's foot, contaminated drinking water
b) cold virus, droplets from a sneeze
c) venereal disease, direct physical contact
d) malaria, mosquito bite
- _____ 23. There is evidence that high population density causes a reduction in individuals' antibody formation and overall resistance to disease. This helps explain the connection between high population density and:
- a) improper diet. c) lack of medical care.
b) epidemics. d) spread of noncommunicable diseases.

- _____ 24. Which disease-causing microorganism is transmitted by the bite of a wood tick?
- a) protozoan that causes African sleeping-sickness
 - b) ameba that causes amebic dysentery
 - c) protozoan that causes malaria
 - d) rickettsia that causes Rocky Mountain spotted fever
- _____ 25. Poor sanitation is the underlying cause for all of the following diseases EXCEPT:
- a) trichinosis
 - b) hookworm disease
 - c) amebic dysentery
 - d) infectious hepatitis
- _____ 26. All of the following play a part in the body's disease defense system EXCEPT:
- a) white blood cells
 - b) production of antigens
 - c) bone marrow
 - d) production of saliva
- _____ 27. According to the theory of immunity, lymphocytes:
- a) "recognize" antigens and produce antibodies to destroy them.
 - b) cause an immune reaction between antigens and bone marrow.
 - c) migrate to lymph nodes in search of antigens.
 - d) produce antigens that stimulate production of antibodies.
- _____ 28. Who was the first person to link diseases with microorganisms?
- a) Joseph Lister
 - b) Edward Jenner
 - c) Louis Pasteur
 - d) Robert Koch
- _____ 29. A successful and widely used technique for isolating and identifying the microbe responsible for a particular disease was devised by:
- a) Robert Koch
 - b) Edward Jenner
 - c) Joseph Lister
 - d) Alexander Fleming
- _____ 30. How does a vaccination work?
- a) Toxins are introduced into the body in order to build up the body's pathogens.
 - b) A person contracts cowpox so that he or she won't get smallpox.
 - c) An antigen for a disease is introduced into the body to create immunity to the disease.
 - d) A person is injected with antibodies that fight a particular disease.
- _____ 31. Which is NOT a correct pairing of drugs and diseases?
- a) sulfa drugs, bacterial pneumonia
 - b) quinine, malaria
 - c) penicillin, diseases caused by bacteria
 - d) tetracycline, antibiotic-resistant strains of bacteria
- _____ 32. Which of the following is NOT a modern tool used to diagnose illness?
- a) X-rays
 - b) radioactive tracers
 - c) pacemaker
 - d) computer

Semester Test 1

Chapters 1-14 Units 1-4

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|---|-------------------------|
| _____ 1. all the chemical reactions that take place in a cell | a) biology |
| _____ 2. pigment in plant leaves that captures energy from sunlight | b) cellular respiration |
| _____ 3. branch of science that deals with classification of organisms | c) chemical reaction |
| _____ 4. the study of living things | d) chlorophyll |
| _____ 5. process by which new compounds are made | e) chloroplast |
| _____ 6. long period of sleep during which an organism's body temperature and rate of metabolism decrease | f) element |
| _____ 7. chemical compounds that contain carbon and hydrogen | g) hibernation |
| _____ 8. group of organisms that look alike and can interbreed to produce offspring also capable of reproducing | h) hydrolysis |
| _____ 9. pure substance that cannot be broken down further into any other substances | i) inorganic compounds |
| _____ 10. structure in plant cells where photosynthesis occurs | j) kingdom |
| | k) metabolism |
| | l) molecule |
| | m) organic compounds |
| | n) species |
| | o) taxonomy |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

botany	ecology	Moneran
coldblooded	fungi	physiology
compounds	ionic	Protist
covalent	molecules	warmblooded

- | | |
|-------|---|
| _____ | 11. Atoms bond together to form chemical _____ . |
| _____ | 12. The simplest living organisms, with no true nuclei, have been grouped in the _____ Kingdom. |
| _____ | 13. Animals that maintain a constant body temperature are termed _____ . |
| _____ | 14. The branch of biology that studies organisms and their relationships to each other and to their environment is called _____ . |
| _____ | 15. Chemical bonds that involve sharing of electrons are called _____ bonds. |

PART **3**

Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. Which of the following statements is TRUE?
- a) Tissue is the basic unit of structure and function in living things.
 - b) Cells of one tissue type are anatomically and functionally similar.
 - c) Organs are grouped into organ systems based on structural similarity.
 - d) Multicellular organisms are not organized above the cellular level.
- _____ 17. Which statement regarding classification of organisms is FALSE?
- a) The Plant Kingdom can be divided into vascular and nonvascular phyla.
 - b) Yeast and mushrooms are classified in the Fungal Kingdom.
 - c) The Animal Kingdom includes phyla of vertebrates and invertebrates.
 - d) The difference between organisms in the Moneran and Protist Kingdoms is that protists are multicellular and monerans are unicellular.
- _____ 18. An electron microscope is able to be used to investigate subcellular structures because it can magnify biological specimens up to
- a) 1000 times b) 100 000 times c) 100 times d) 1 000 000 times
- _____ 19. Which of the following is NOT a class of vertebrates?
- a) reptiles b) insects c) mammals d) amphibians
- _____ 20. The statement, "Cells are the basic unit of structure of living things," is part of the:
- a) cell theory c) scientific method
 - b) heterotroph hypothesis d) theory of abiogenesis
- _____ 21. Each of the following statements concerning nutrition is true EXCEPT:
- a) Nutrients are food substances that the body cannot manufacture.
 - b) Grains are a good source of all essential amino acids.
 - c) Plant fats and oils supply lipids for building cell structures.
 - d) Calcium and potassium are minerals important to body functioning.
- _____ 22. Which statement about enzymes is FALSE?
- a) They decrease the activation energy needed to begin a reaction.
 - b) They are composed of protein.
 - c) They attach to substrates in biological reactions.
 - d) Their effectiveness is not related to surrounding pH or temperature.
- _____ 23. When following the scientific method in studying living things, what procedure would NOT be used?
- a) Design and conduct a controlled experiment.
 - b) Include a variable in the experiment.
 - c) Test a hypothesis based on observations and experiment.
 - d) Formulate a hypothesis based on results obtained from experiments.

- _____ 24. Starch molecules are synthesized in a plant cell by the bonding together of:
a) monosaccharides b) nucleotides c) amino acids d) fatty acids
- _____ 25. During photosynthesis:
a) oxygen and sugar are converted to carbon dioxide and energy.
b) chlorophyll is produced.
c) carbon dioxide and water combine to form glucose.
d) sunlight and chlorophyll react to form energy-rich proteins and sugars.
- _____ 26. Which relationship between structure and function in a plant leaf is INCORRECT?
a) palisade layer/photosynthesis c) vein/water
b) epidermis/protection d) stroma/gas exchange
- _____ 27. Trace the path of energy during the process of photosynthesis:
1. Energy is stored in chemical bonds of ATP and NADPH.
2. Energy is stored in energized electrons in chlorophyll molecules.
3. Energy is stored in bonds of glucose molecules.
4. Energy from the sun reaches plants.
a) 4, 2, 1, 3 b) 3, 2, 1, 4 c) 4, 1, 2, 3 d) 4, 3, 2, 1
- _____ 28. A person's metabolic rate can be determined by measuring:
a) body temperature. c) consumption of oxygen over a period of time.
b) level of daily activity. d) consumption of glucose over a period of time.
- _____ 29. What could cause lactic acid to accumulate in a person's muscle cells?
a) strenuous exercise b) sleeping c) fasting d) fever
- _____ 30. Which of the following glands secretes several hormones and influences other glands?
a) adrenal medulla b) pituitary c) testes d) pancreas
- _____ 31. The autonomic nervous system:
a) controls involuntary activity of internal organs.
b) is part of the central nervous system.
c) counteracts the effect of nerve impulses from the spinal cord.
d) sends nerve impulses to skeletal muscles.
- _____ 32. Which of the following does NOT play a part in regulating the activity of the heart?
a) nervous system b) hormones c) sinoatrial node d) heart valves
- _____ 33. What phenomenon does the cohesion-tension theory attempt to explain?
a) why water evaporates from leaves on a hot day
b) how water moves upward in plants against the force of gravity
c) how sap moves from leaves to phloem
d) why water molecules have an attractive force between them
- _____ 34. Which of the following structures is NOT involved with excretion of wastes?
a) contractile vacuoles b) flagella c) Malpighian tubules d) stomates

PART 4 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|--|--------------------|
| _____ 35. muscle above the abdominal cavity that is involved in the process of breathing | a) artery |
| _____ 36. blood vessel that carries blood away from the heart | b) chemoreceptor |
| _____ 37. organ that converts ammonia formed in the breakdown of amino acids to urea | c) diaphragm |
| _____ 38. sensory cell that detects light | d) digestive tract |
| _____ 39. tube with two openings that functions in the breakdown of food | e) endocrine gland |
| _____ 40. organ that secretes hormones directly into the bloodstream | f) gallbladder |
| _____ 41. digestive organ that stores bile | g) kidney |
| _____ 42. structure of the eye that bends incoming light rays | h) lens |
| _____ 43. structure that carries urine from the kidney to the bladder | i) liver |
| _____ 44. secretion that aids in passage of food through the digestive tract | j) lung |
| | k) mucus |
| | l) photoreceptor |
| | m) ureter |
| | n) urethra |
| | o) vein |

PART 5 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

brain
diabetes
hemoglobin
homeostasis

HCl
hypoglycemia
iron
metabolism

muscle twitch
peripheral nerves
reflex arc
spinal cord

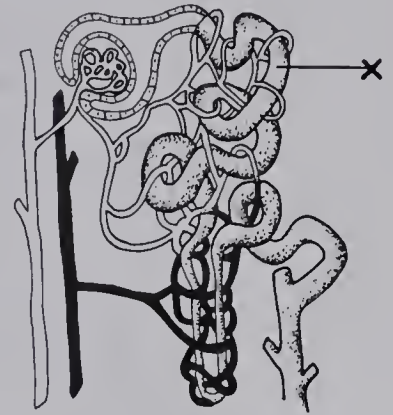
- _____ 45. The maintenance of a balanced internal environment, involving regulation of glucose levels, pH, temperature, carbon dioxide, etc. is called _____.
- _____ 46. The central nervous system includes the _____ and the _____.
- _____ 47. The molecule that carries oxygen in the blood is _____.
- _____ 48. A simple nerve pathway is called a _____.
- _____ 49. _____ is a disease caused by lack of insulin.

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PART **6** Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

The following two questions are related to the diagram shown.

- _____ 50. The entire diagram represents:
- a) medulla of the kidney
 - b) renal artery and capillaries
 - c) a nephron
 - d) a kidney
- _____ 51. What process occurs in structure X?
- a) pumping of filtrate into this structure
 - b) absorption of urea into the blood
 - c) collection of urine for excretion from the body
 - d) reabsorption of glucose, salts, etc. into the blood



- _____ 52. Which statement describing the membranes where gas exchange takes place in a multicellular animal is FALSE?
- a) Carrier molecules move carbon dioxide and oxygen molecules across the membrane.
 - b) There is a rich supply of blood to the membrane.
 - c) The membrane is moist.
 - d) The membrane has a large surface area.
- _____ 53. Which of the following statements concerning enzymes is FALSE?
- a) Digestive enzymes speed up the chemical reactions that break down food molecules.
 - b) The pancreas releases enzymes into the small intestine.
 - c) Bile salts are a type of enzyme secreted by the liver.
 - d) Examples of digestive enzymes include lipase, amylase, and sucrase.
- _____ 54. A villus is best described as a:
- a) part of the digestive tract where most water is absorbed.
 - b) structure in the lining of the small intestine through which nutrients are absorbed into the bloodstream.
 - c) membrane through which gas exchange takes place.
 - d) gland in the lining of the small intestine that secretes digestive enzymes.
- _____ 55. A circulatory disease characterized by high blood pressure is:
- a) hypertension
 - b) varicose veins
 - c) stroke
 - d) aneurism
- _____ 56. The conduction of a nerve impulse does NOT involve:
- a) movement of ions across the neuron membrane.
 - b) releasing of transmitter substance into the synapse between neurons.
 - c) change in permeability of the neuron membrane.
 - d) movement of positively charged ions across the synapse.

Addison-Wesley BIOLOGY

- _____ 58. All of the substances mentioned below are normally excreted by the body EXCEPT:
a) amino acids b) urea c) carbon dioxide d) excess water
- _____ 58. Place the following events involved with hormone action in the proper sequence:
1. Receptor molecules in or on target cells bind with hormone.
2. Hormone is carried in the bloodstream.
3. Target cells start or stop producing enzymes or other substances.
4. An endocrine gland synthesizes and secretes a hormone.
a) 3, 4, 2, 1 b) 4, 1, 3, 2 c) 4, 2, 1, 3 d) 1, 3, 4, 2
- _____ 59. What part of the brain helps maintain balance and coordinates muscle activity?
a) cerebrum b) cerebellum c) spinal cord d) brainstem
- _____ 60. Which is a CORRECT description of the relationship between locomotion and the nervous system?
a) Nerves supply muscle cells with energy and calcium to enable contraction.
b) Locomotion is the result of muscle contractions caused by nerve impulses.
c) The brain sends chemical messages to muscles, causing them to contract.
d) There is little direct interaction between the two systems.
- _____ 61. How are cellular respiration and respiration (exchange of gases) related?
a) Respiration takes place in all the cells of the body, while cellular respiration takes place only in the lungs.
b) Cellular respiration could not occur without a mechanism for gas exchange.
c) Energy for respiratory activities comes from glucose produced during cellular respiration.
d) There is no relationship between the two processes.
- _____ 62. The major difference between an insect's compound eye and a vertebrate eye is:
a) An insect eye cannot form images, whereas a vertebrate eye can.
b) A vertebrate eye includes a retina, while an insect eye does not.
c) An insect eye has many lenses, while a vertebrate eye has only one lens.
d) A vertebrate eye contains pigments that detect light; an insect eye has none.
- _____ 63. Which of the following structures in the human ear consists of a membrane that vibrates?
a) anvil b) cochlea c) eardrum d) Eustachian tube
- _____ 64. Damage or disease affecting the semicircular canals in the inner ear could result in the loss of:
a) hearing b) balance c) sight d) touch
- _____ 65. The structure in a vertebrate eye that contains circular muscles that control the amount of light entering the eye is the:
a) pupil b) lens c) cornea d) iris

Semester Test 2

Chapters 15-26 Units 5-8

PART 1 Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|---|--------------------|
| _____ 1. cellular structure made of microtubules that is evident during mitosis and meiosis | a) antibody |
| _____ 2. accidental change in a DNA molecule | b) antigen |
| _____ 3. asexual reproductive process in amebas | c) binary fission |
| _____ 4. organ that functions in exchange of materials between mother and fetus | d) budding |
| _____ 5. regularly-repeated sequence of events during which a human egg develops and the uterus lining thickens | e) dispersal |
| _____ 6. protein in the body that destroys specific foreign substances | f) chemotherapy |
| _____ 7. treatment of disease by using chemicals | g) estrus |
| _____ 8. introducing dead or weakened pathogens into the body to build up antibodies against a specific disease | h) gene mutation |
| _____ 9. process by which populations of organisms move to new locations | i) immunity |
| _____ 10. type of asexual reproduction found in the hydra | j) lymphocyte |
| | k) menstrual cycle |
| | l) placenta |
| | m) spindle |
| | n) umbilical cord |
| | o) vaccination |

PART 2 Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

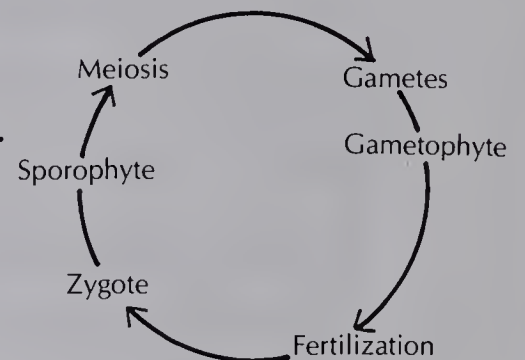
annuals	epidemiology	life zone
deciduous	food chain	Oparin
energy pyramid	immune reaction	Pasteur
epidemic	latitude	perennials

- | | |
|-------|---|
| _____ | 11. A(n) _____ shows the amount of energy transferred from producers to consumers within an ecosystem. |
| _____ | 12. The idea of abiogenesis was disproved by _____ in his experiments using swan-neck flasks. |
| _____ | 13. Plants that grow and reproduce in one season and then die are called _____. |
| _____ | 14. An outbreak of a disease that affects large numbers of individuals in an area is called a(n) _____. |
| _____ | 15. A particular biome is located on a globe by referring to its _____. |

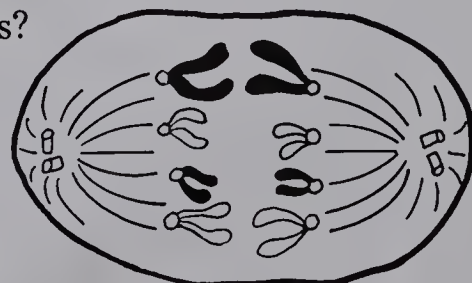
PART 3

Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

- _____ 16. In terms of survival, which characteristic of asexual reproduction would be a disadvantage in adapting to new environmental conditions?
- a) no variation in traits c) offspring are clones
b) one parent produces offspring d) spores can remain dormant
- _____ 17. Which is an example of sexual reproduction?
- a) A fern plant undergoes meiosis to form spores, which then develop into new fern plants (gametophyte generation).
b) An ameba divides by the process of binary fission.
c) A cutting from a geranium plant grows into a new plant.
d) An acorn grows into an oak tree.
- _____ 18. Based on the diagram of the life cycle of a flowering plant, which statement is CORRECT?
- a) Both sporophyte and gametophyte are haploid.
b) The gametophyte is the dominant generation.
c) Fertilization results in a diploid zygote.
d) Meiosis results in diploid gametes.
- _____ 19. Secondary growth:
- a) is found in all plants. c) causes trees to increase in height.
b) takes place in apical meristems. d) results in the formation of wood.
- _____ 20. Why is meiosis important to organisms that reproduce sexually?
- a) It produces daughter cells identical to the parent cell.
b) The chromosome number is halved in gametes, so that the zygote has the diploid number.
c) It is necessary for the zygote to grow.
d) Recessive alleles are eliminated during the process.
- _____ 21. Which of the following statements concerning sexual reproduction is FALSE?
- a) Species that reproduce sexually are made up of either male or female individuals.
b) Gametes formed by male animals are called sperm.
c) The union of two gametes (from two parents) is known as fertilization.
d) Internal and external fertilization are both found in sexual reproduction.



- _____ 22. The cell shown is in what stage of mitosis?
- a) prophase
b) anaphase
c) telophase
d) metaphase

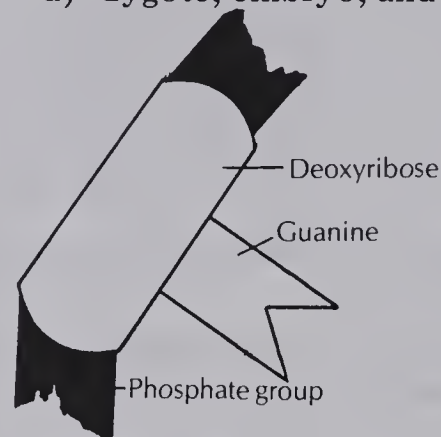


_____ 23. The early stages of embryonic development of a vertebrate zygote produce the first layers of body tissues, called:

- a) morula, blastula, and gastrula.
- b) endoderm, ectoderm, and mesoderm.
- c) chorion, amnion, and yolk sac.
- d) zygote, embryo, and fetus.

_____ 24. What is represented by the diagram:

- a) DNA molecule
- b) DNA nucleotide
- c) double helix
- d) a gene



_____ 25. Infectious diseases are NOT:

- a) usually communicable diseases.
- b) able to be transmitted in some cases by a sneeze.
- c) caused by microorganisms known as pathogens.
- d) diseases such as emphysema, hemophilia, or diabetes.

_____ 26. Drug abuse:

- a) results in harmful physical effects in only the most addicted individuals.
- b) can apply to use of alcohol, nicotine, mind-altering drugs, or narcotics.
- c) does not often result in physical addiction to a particular drug.
- d) is not a major problem in North America.

_____ 27. Which of the following accurately pairs an example of social behavior with its function?

- a) Honeybee workers perform waggle dances to stimulate the queen to lay eggs.
- b) A wolf pack urinates around its home area to attract mates.
- c) A dog stands in aggressive postures to signal the beginning of physical combat with an opponent.
- d) Dominant male baboons display ritual behavior to reduce aggressive behavior within the troop.

_____ 28. Which statement concerning cyclic behaviors is FALSE?

- a) Circadian rhythms involve behaviors that repeat about every 24 hours.
- b) Some body rhythms continue even when the environment is changed artificially.
- c) Some organisms are not affected by natural cycles and rhythms.
- d) Humans seem to possess circadian rhythms.

_____ 29. Flatworms given an electric shock contract their muscles and shorten their bodies. In an experiment an electric shock was given to worms while simultaneously turning on a light. This was repeated many times. Finally, when the light was turned on without giving any electric shock the worms responded by contracting their muscles. This behavior is an example of:

- a) habituation
- b) classical conditioning
- c) imprinting
- d) instinct

PART **4** Match each item in the left column with an item in the right column. Write the *letter* of the correct answer in the space at the left.

- | | |
|--|----------------------|
| _____ 30. chemical substance that influences the behavior of other organisms of the same species | a) ammonification |
| _____ 31. an example of social dominance in chickens | b) estuary |
| _____ 32. process by which some types of bacteria convert nitrogen in the air to nitrates | c) fossils |
| _____ 33. group of interbreeding organisms living in the same area | d) host |
| _____ 34. organism that supplies food and/or shelter to other organisms | e) inbreeding |
| _____ 35. role of an organism within an ecosystem | f) meristem |
| _____ 36. aquatic ecosystem characterized by a mixture of fresh and salt water | g) niche |
| _____ 37. plant tissue in which cells are growing and dividing | h) nitrogen fixation |
| _____ 38. preserved traces of organisms that lived in the past | i) parasite |
| _____ 39. mating of close relatives to establish offspring homozygous for certain traits | j) pecking order |
| | k) pheromone |
| | l) population |
| | m) ritual |
| | n) river |
| | o) vascular tissue |

PART **5** Selecting from the words listed below, complete each of the following sentences by writing the missing word(s) in the space(s) at the left.

banding
Darwin
diploid
gene map

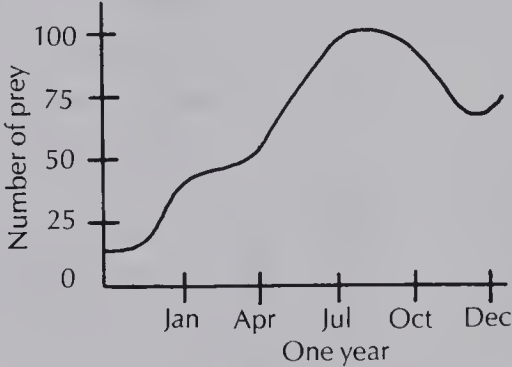
haploid
heterozygous
homozygous
Lamarck

protein synthesis
Punnett square
replication
reproduction

- _____ 40. _____ is the process in which DNA makes an exact copy of itself.
- _____ 41. Gametes formed from meiosis have the _____ number of chromosomes.
- _____ 42. When the two alleles for a gene are different, the organism is said to be _____ for the trait.
- _____ 43. _____ proposed the theory of evolution by natural selection.
- _____ 44. A diagram showing where genes are located on particular chromosomes is called a(n) _____.

PART 6 Complete each of the following statements by placing the *letter* of the correct answer in the space at the left.

An ecologist observes a community of organisms on a rotting oak log in a forest. Covering much of the bark are lichens and mushrooms. A piece of bark pulled away reveals several species of wood-eating bark beetle larvae and land snails. A centipede is eating larvae on exposed wood showing traces of termite tunneling. A carnivorous beetle that was feeding on a firefly larva is itself captured and eaten by a garter snake. (Answer the following two questions based on this description.)

- _____ 45. Which is NOT an accurate description of energy transfers within this ecosystem?
- The bark beetle larvae acquire energy from wood.
 - The energy stored in the oak tree came originally from the sun.
 - The garter snake received energy that was stored in the beetle's body.
 - The mushrooms acquire energy directly from the sun.
- _____ 46. The carnivores in the situation described are:
- centipede, carnivorous beetle, and garter snake
 - termites and bark beetles
 - lichens and mushrooms
 - land snails
- _____ 47. Population growth of a species of prey animal was graphed for a year. What interpretation of the graphed data is most likely to be correct?
- The population doubled in size over the year.
 - The curve is typical of a population crash.
 - At the beginning of the year the birth rate equaled the death rate.
 - The population decreased in the fall due to cooler climate or increased predation.
- 
- _____ 48. Which of the following statements concerning the human population is FALSE?
- Agricultural advances have decreased the environment's carrying capacity.
 - Medical technology has reduced the death rate in the human population.
 - Population increase each year depends on birth and death rates.
 - The world population is growing in size.
- _____ 49. In 1980, the squirrel population in Central Park was estimated to be 950. If birth rate = 10 squirrels per year, death rate = 12 squirrels per year, immigration averages 5 squirrels per year, and emigration averages 2 squirrels per year, what will the population be in 1984?
- 954
 - 965
 - 1000
 - 1010
- _____ 50. The climax stage of ecological succession:
- changes rapidly to the next stage.
 - is the first stage of succession.
 - is maintained until the climate changes.
 - is represented by either deciduous or conifer forests.

Addison-Wesley BIOLOGY

- _____ 51. Which of the following is NOT a correct association of climax plants with biome?
- a) cactus plants/desert c) broad-leaf evergreen trees/tropical rain forest
b) coniferous trees/tundra d) maple and beech trees/deciduous forest
- _____ 52. Within the cell, protein synthesis follows the sequence:
- a) RNA, DNA, protein c) DNA, mRNA, tRNA, protein
b) protein, mRNA, tRNA, DNA d) DNA, tRNA, rRNA, protein
- _____ 53. Which of the following statements is INCORRECT?
- a) Two or more alleles make up a gene.
b) The same gene is located in the same locus on each homologous chromosome.
c) Chromosomes are composed of DNA molecules and protein.
d) Genes are portions of DNA in a chromosome.
- _____ 54. Suppose a man with type AB blood marries a woman with type A blood. What blood type would NOT be found in their children?
- a) type A b) type B c) type AB d) type O
- _____ 55. Mendel's law of independent assortment states that:
- a) a gene whose effect is seen is dominant.
b) a gene goes into a sperm or egg independently of other genes.
c) genes combine at random during fertilization.
d) genes linked on a chromosome are inherited together.
- _____ 56. In fruit flies, normal body color (N) is dominant over ebony body color (n). If all the F₁ generation have normal body color, which of the following are likely to be the genotypes of the parents?
- a) Nn × Nn b) nn × Nn c) nn × nn d) NN × Nn
- _____ 57. Colorblindness in humans is a sex-linked trait carried on the X chromosome. What are the chances that a colorblind man will pass the trait to his offspring?
- a) 0% c) 0% of the girls and 100% of the boys
b) 50% of the girls and 50% of the boys d) It depends on the mother's genotype.
- _____ 58. A human genetic disorder called Down's syndrome is traced to nondisjunction during meiosis of an egg cell that is later fertilized. How many chromosomes are in each cell of a Down's syndrome child?
- a) 45 b) 46 c) 47 d) 48
- _____ 59. Which of the following statements concerning natural selection is INCORRECT?
- a) Phenotypes vary due to mutations and recombinations of genes.
b) Not all organisms born will survive.
c) Organisms that possess the best-adapted phenotypes survive.
d) Mutations appearing during a person's lifetime cannot be transmitted to their offspring.

Answer Key

Chapter 1 <ol style="list-style-type: none">bgjikocelhbiologyproducercellszoologynucleusbcdbbdacbddacbdaccb	Chapter 3 <ol style="list-style-type: none">imdncfaeokmicroscopemicrographscientific methodnucleus; cell membranecelluloseccbbadbadbcaabdacbd	Chapter 5 <ol style="list-style-type: none">fkdblcneijoxygenvan HelmontvitaminscarbohydratesCalvindbbabadabdbbccc	Chapter 7 <ol style="list-style-type: none">eflndaifgkexoskeletonspiracleoxygenatedoxygen; carbon dioxidebreathingbdacbbcacaaacdc
Chapter 2 <ol style="list-style-type: none">jfbdkalmceblue-green algaetracheophytesprotozoamonocotsannelidscdbbcaadbbaacaaddcd	Chapter 4 <ol style="list-style-type: none">hbakjicdlfelectronacidicorganicionicpeptidecdbaccbdbddcaaccc	Chapter 6 <ol style="list-style-type: none">geaolnckimanaerobiclactic acid; ethanolaerobicNAD⁺ATPbdadaaabcdaabb	Chapter 8 <ol style="list-style-type: none">jfngakebmhchemicalextracellularhormonesmaltaseulcerbcacbadddaaccbc

Chapter 9

1. l
2. c
3. i
4. d
5. b
6. k
7. h
8. o
9. a
10. g
11. homeostasis
12. aorta
13. osmosis, xylem
14. lacteal
15. bone marrow
16. c
17. c
18. a
19. d
20. c
21. d
22. c
23. b
24. a
25. d
26. c
27. a
28. b
29. b
30. ~~c~~ b
31. b
32. c

Chapter 10

1. n
2. e
3. i
4. b
5. a
6. c
7. d
8. g
9. m
10. l
11. uric acid
12. urine; water
13. carbon dioxide
14. ammonia
15. nephridia
16. c
17. d
18. a
19. a
20. d
21. c
22. b
23. a
24. b
25. c
26. a
27. c
28. b
29. d
30. d
31. a
32. b

Chapter 11

1. c
2. g
3. k
4. h
5. o

Chapter 11 (continued)

6. a
7. j
8. f
9. l
10. i
11. atrophy
12. actin; myosin
13. exoskeleton
14. appendages
15. voluntary
16. c
17. c
18. a
19. d
20. a
21. c
22. d
23. a
24. b
25. a
26. b
27. b
28. b
29. a
30. d
31. b

Chapter 12

1. k
2. m
3. e
4. l
5. o
6. a
7. f
8. n
9. j
10. g
11. cytokinins
12. endocrine
13. *Diabetes mellitus*
14. goiter
15. ovulation
16. b
17. d
18. d
19. c
20. c
21. b
22. a
23. c
24. d
25. b
26. c
27. d
28. b
29. c
30. c

Chapter 13

1. o
2. d
3. m
4. e
5. b
6. k
7. n
8. j
9. a
10. l
11. receptor
12. dendrites
13. synapse

Chapter 13 (continued)

14. meninges
15. gray matter
16. a
17. c
18. b
19. d
20. c
21. b
22. a
23. b
24. c
25. a
26. b
27. d
28. a
29. c
30. b
31. c
32. b
33. d

Chapter 14

1. f
2. b
3. l
4. o
5. e
6. c
7. g
8. n
9. d
10. k
11. thermoreceptors
12. vitreous humor
13. receptors; brain
14. tympanic membranes
15. anvil; hammer; stirrup
16. a
17. b
18. c
19. d
20. b
21. c
22. a
23. b
24. b
25. c
26. b
27. c
28. d
29. b
30. c
31. a
32. c
33. c

Chapter 15

1. f
2. c
3. i
4. m
5. l
6. j
7. o
8. h
9. k
10. g
11. adenine; guanine
12. mitosis
13. cancer
14. double helix
15. cell plate
16. a

Chapter 15 (continued)

17. c
18. d
19. d
20. b
21. c
22. d
23. c
24. b
25. a
26. b
27. c
28. c
29. a
30. d
31. c

Chapter 16

1. n
2. f
3. g
4. c
5. a
6. j
7. m
8. o
9. e
10. i
11. sexual
12. diploid
13. tetrad
14. sperm
15. heterogametes
16. a
17. c
18. d
19. b
20. d
21. a
22. c
23. a
24. b
25. c
26. b
27. a
28. d
29. a
30. d

Chapter 17

1. d
2. g
3. a
4. j
5. b
6. e
7. h
8. l
9. c
10. i
11. calyx; corolla
12. pollen grain
13. apical
14. perennial
15. cork cambium; phloem
16. a
17. d
18. c
19. b
20. d
21. d
22. c
23. a
24. c

Optional Essay Questions

77
32
45

INTRODUCTION

The essays that follow are offered for use either in conjunction with the objective tests or as an additional testing tool. There are two essay questions for each of the 26 text chapters; two semester tests of three questions each are also included. The questions are not meant to be comprehensive for the chapters, but only to emphasize highlights of the material covered in each chapter.

Each essay question is designed to require approximately ten minutes to answer completely. If both questions are used along with the objective test, the added test time would be about 20 minutes. You may wish to substitute the essays for a section of the objective test or leave that as an option for the student. The answers given here are possible answers and are not meant to be definitive. A score of 10 to 15 percent per essay question is recommended, depending on whether or not the essay questions supplement the objective test or are substituted for a part of that test.

CHAPTER 1

1. The first chapter introduces the scientific discipline of biology. Write an essay that includes a definition of biology, a brief survey of the specializations and research activities of biologists, and a description of the relevance of biological study.

As the study of living things, biology includes a large body of factual information as well as a variety of research activities involving living organisms. It is a very broad field and can be broken down into more specialized areas. For example, botany is the study of plants, and zoology is the study of animals. Within these areas there are specialized research interests, including behavior, ecology, physiology, anatomy, and others.

Biologists make observations and perform experiments. Research is conducted in laboratories as well as in natural settings. Often the research conducted by biologists is important in solving human problems. Biologists seek to cure diseases, improve food crops and livestock, and solve pollution and other environmental problems. Studying biology can help people to understand more about their own bodies and the living things in their natural environment.

2. Written communication can be divided

Chapter 1 continued

into levels of organization. For example, letters of the alphabet are put together to form words. Words combine to make sentences, which make up paragraphs. Chapters are made of paragraphs and are themselves components of books. Thus, a book is a written communication that contains many simpler levels of organization.

Draw an analogy with this example to discuss the levels of organization in living things. Begin with the cell and include the structure of multicellular organisms and biological communities. Use examples to illustrate your analogy.

In considering living things, the simplest level of organization is the cell. All living things are made up of cells. Cells themselves share some characteristics (all have water, salts, and a cell membrane) but also display significant differences. Cells of different types of tissues. Plant organs include roots, stems, and leaves. Examples of organs in animals include tissue. The cells within a particular tissue would be quite similar in size, shape, and function. However, tissues differ in appearance and function, depending on the type of cells making up the tissue. Examples of tissues are bone and muscle in animals. Organs are more complicated structures made up of different types of tissues. Plant organs include roots, stems, and leaves. Examples of organs in animals include lungs and stomach. Each organ has a different function and structure. Organs that work together to perform overall functions comprise an organ system. Organ systems vary a great deal from one another and accomplish different life processes, such as digestion or movement in animals.

Organ systems make up organisms. Some examples of multicellular organisms are seaweed, pine trees, bees, and humans. Basic similarities exist between all organisms since each living thing must obtain energy, maintain life processes, and respond to its environment. However, organisms accomplish these essential life functions in a variety of ways. For example, unicellular organisms do not have the complicated organ systems of a multicellular organism. Plants can capture energy directly from the sun while animals and decomposers must obtain energy from other living things. Humans respond to their environment in a more complex manner than a unicellular organism.

Organisms living in the same area and interacting with one another make up a community. Communities differ from one another because they are composed of different organisms. For example, a pond community has different plants and animals than would be found in a forest community.

The levels of complexity increase in biological systems, from multicellular organism to communities

Chapter 1 continued

of organisms, in the same way that words are arranged into sentences, paragraphs, chapters, and books, each level of organization including the elements from the previous level.

CHAPTER 2

1. In a brief essay, write an overview of taxonomy. Include a definition of taxonomy, an explanation of scientific names and their importance, and an outline of the criteria used to categorize organisms, in particular the criteria to establish members of a species.

Taxonomy is the science of classifying and naming organisms. Taxonomists assign to each organism they classify a scientific name, which consists of the genus and species names. Scientific names are used uniformly throughout the world to avoid the confusion that would result from using more than one common name for an organism.

Genus and species and other taxonomic categories are assigned after study and comparison of various physical features of organisms. Comparisons may be made based on internal and external body structures, chemical analyses of blood or other proteins, or differences in reproduction or development. Organisms classified into the same species are able to interbreed and produce offspring similar to themselves.

2. In a brief essay, name the five kingdoms, list characteristics of each, and give one or several examples of organisms in each kingdom.

The five-kingdom classification system divides organisms into monerans, protists, fungi, plants, and animals. Members of the Moneran Kingdom are all prokaryotes, meaning that they lack a true nucleus in their cells. This kingdom is made up of two groups: bacteria and blue-green algae. The Protist Kingdom includes one-cell eukaryotes, which have a true nucleus in their cells. Protozoa and diatoms are protists. The Fungal Kingdom is made up mostly of multicellular decomposers that lack chlorophyll and cannot produce their own food. Mushrooms and molds are familiar members of the Fungal Kingdom. Plants are similar to fungi in that they are multicellular eukaryotes. However, plants possess chlorophyll and are therefore capable of producing their own food. Also, most plants are more complex than fungi in structure. The Plant Kingdom includes multicellular algae, mosses, ferns, flowering plants (including trees), and conifers. The Animal Kingdom includes organisms that can move around and that are multicellular consumers. Animals without backbones are called invertebrates and include sponges, worms, and insects. Animals with backbones, or vertebrates, include fish, snakes, frogs, and mammals.

CHAPTER 3

1. This chapter has discussed the use of four types of microscopes: the light microscope, electron microscope, scanning electron microscope, and phase contrast microscope. Assume

Chapter 3 continued

you are a scientist examining a housefly. Describe which microscope is best for observing the fly at the organismic, cellular, and subcellular levels. Include the maximum magnification that can be obtained with each type of microscope.

The best microscope for observing a living housefly, its behavior and functioning structures, would be the phase contrast microscope. This microscope can magnify the specimen up to 1000x and it is not necessary to kill the specimen. The light microscope would be used to examine tissue removed from the fly, enabling individual cells to be examined up to 1000x magnification. If greater detail was needed, a very thin piece of tissue could be observed using the electron microscope, which magnifies biological material up to 100 000x normal size. This microscope would make even subcellular structures of the housefly cells visible. The shapes of these subcellular structures would be made even more visible using the scanning electron microscope, which bounces electrons off of an object instead of passing them through the object.

2. To remain alive each cell must obtain food and get rid of wastes. Choose *four* of the following six organelles and explain how each performs a function that helps to keep a cell alive. (Choose from: cell membrane, endoplasmic reticulum, lysosomes, mitochondria, nucleus, vacuoles).

The cell membrane determines what goes into and out of a cell. It allows food to enter and wastes to leave. In addition, it prevents many harmful substances from entering the cell. The endoplasmic reticulum transports substances within the cell. This system of folded membranes functions in moving proteins and other substances to where they are needed in the cell.

Lysosomes are important in keeping the cell alive because they contain enzymes that digest food, which is the source of the cell's energy and building materials. Lysosomes also break down waste products and destroy worn out cells and their parts. The mitochondria contribute to keeping the cell alive by producing ATP, a molecule that acts as the energy source for the cell. The nucleus controls all the functions of the cell. It directs the production of the materials made by the cell, controls reproduction of the cell, and stores information about the cell's heredity. Vacuoles function by storing food and water for the cell. In plants vacuoles serve as dump sites for poisonous wastes.

CHAPTER 4

1. List the four major types of organic compounds found in living things. Describe the basic structure of each of these and give examples whenever possible.

The four major types of organic compounds found in living things include carbohydrates, lipids, proteins,

Chapter 4 continued

and nucleic acids. Carbohydrates include simple sugars, such as glucose, disaccharides, such as sucrose, and chains of simple sugars bonded together to form large polysaccharides, such as starch. Lipids include fats, oils, and waxes and are produced in both plants and animals. Butter is a kind of fat; plant oils include corn oil and soybean oil; beeswax and the outer covering of many plant leaves are examples of waxes. The building blocks of lipids are fatty acids and glycerol. Fatty acids are composed of chains of carbon atoms bonded to hydrogen atoms. Depending on the type of bonds found in fatty acids, the fat is either saturated or unsaturated. Fats that have fatty acids with only single bonds between carbon atoms are called saturated fats. Unsaturated fats have fatty acids with double bonds between carbon atoms.

Proteins, such as insulin, are composed of chains of amino acids bonded together. An amino acid is made up of a central carbon atom attached to an amino group, an organic acid group, a hydrogen atom, and an R group. Nucleic acids are composed of chains of nucleotides. Each nucleotide contains a phosphate group, a sugar, and a nitrogen base. Important nucleotides include AMP, ADP, and ATP. DNA and RNA are examples of nucleic acids.

2. In a short essay, define the term *enzyme*, describe how enzymes function, and discuss the effect of environmental conditions upon enzymes. Include in your answer the terms *lock and key theory*, *activation energy*, *temperature*, and *pH*.

Proteins that speed up chemical reactions in living cells are called enzymes. In other words, an enzyme is a special type of catalyst. Enzymes speed up biological reactions by lowering the activation energy needed to cause the reaction to occur. The lock and key theory proposes that enzymes are shaped in such a way that they fit together with the substrate molecules in the same way a key fits a lock. Thus, when the substrate molecules attach to the enzyme they come close enough together to react easily. Enzymes are very sensitive to temperature and are not effective at low or very high temperatures. Enzymes are also very sensitive to the pH of solutions. Every enzyme has an optimum temperature range and an optimum pH range.

CHAPTER 5

1. The food we eat provides us with energy and other raw materials we need for our bodies to function properly. In an essay, answer the following two questions about the meal described below. (a) Would the meal provide adequate energy to sustain a person for one day? (b) List the nutrients needed by the human body and evaluate the meal in terms of its ability to meet those nutritional needs. Provide at least one specific example of which food supplies each nutrient present in the meal.

Chapter 5 continued

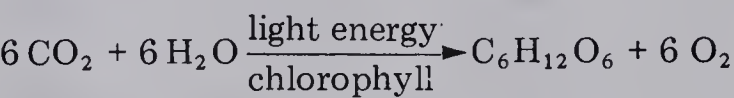
Meal: One glass of milk, one piece of chicken, one serving of brown rice (whole grain) with butter, one large salad of green and yellow vegetables, one piece of fruit, and cookies.

The rice and cookies are both sources of carbohydrates and will therefore provide energy quickly to the person eating the meal. However, the amount of energy supplied may or may not be adequate, depending on the person's age, sex, weight, and activity level. Since everyone has different energy requirements, the meal might be adequate for some (small, inactive people) and not for others (large, active people).

Besides carbohydrates, the body also needs four other nutrients: proteins, lipids, vitamins, and minerals, to maintain proper body functioning. The meal supplies proteins, since milk and chicken are both good sources of protein. The butter would fulfill the need for lipids. The need for vitamins would be met by several foods. For example, milk would supply vitamins A and D, the vegetables contain vitamins A, B₆, folic acid, E, and K. Various minerals would be furnished by eating this meal since rice contains phosphorus and iron, milk has calcium, phosphorus, sulfur, and potassium, and salad vegetables contain calcium, magnesium, iron, and iodine.

In summary then, the meal has been shown to be well balanced since the various foods would supply each important nutrient: carbohydrates, proteins, lipids, vitamins, and minerals.

2. The equation for photosynthesis is:



Describe in your own words the sequence of events represented by this equation, mentioning the molecules that store energy or provide energy for the light and dark reactions.

During photosynthesis light energy from the sun is converted to chemical energy and stored in molecules of the simple sugar glucose. As a by-product of this process, oxygen is produced. The carbon dioxide and water listed on the left side of the equation supply the raw materials for making glucose and oxygen.

During the light reactions light energy is converted to chemical energy and stored temporarily in molecules of ATP and NADPH. At the same time the water molecules are split, releasing oxygen. During the dark reactions glucose is synthesized from hydrogen and carbon dioxide using energy supplied by the ATP and NADPH formed during the light reactions.

CHAPTER 6

1. Summarize the breakdown of a molecule of glucose during cellular respiration, explaining the three main stages of the process, the importance of oxygen, and the end products produced.

Chapter 6 continued

During the first stage of cellular respiration, known as glycolysis, glucose molecules are broken into molecules of pyruvic acid. This releases a small amount of energy, which is stored in ATP. Energized electrons from glucose are stored in molecules of NADH.

Each molecule of pyruvic acid formed in glycolysis enters the citric acid cycle, the second stage of cellular respiration. First, the pyruvic acid combines with other compounds to form a molecule of citric acid. The citric acid molecules are then broken apart by enzymes. During these reactions, many energized electrons are released and stored in NADH. In addition, some ATP is also made.

The NADH molecules formed during glycolysis and the citric acid cycle pass the energized electrons to other compounds during the third stage, known as electron transport. As the electrons are passed from compound to compound in electron transport they lose energy. This energy goes into the production of many ATP molecules. Oxygen serves as the final acceptor of the de-energized electrons. Oxygen is essential to cellular respiration because the citric acid cycle and electron transport processes will not occur if oxygen is not present.

The end products of cellular respiration are carbon dioxide, water, and ATP molecules. ATP stores the energy originally held in the chemical bonds of glucose molecules.

2. In a short essay define metabolism and metabolic rate, and discuss the factors that cause metabolic rate differences within a species of animal (for example, humans) and between species of animals (for example, coldblooded and warmblooded animals).

Metabolism refers to all the chemical reactions going on in the cells of a living organism. The speed at which these reactions occur is known as the metabolic rate. The rates of energy usage vary within a species of organisms. For example, individuals who are more active physically have greater energy needs and therefore have higher metabolic rates. Also, younger or actively growing individuals tend to have higher rates of metabolism due to their higher energy demands.

Between species of animals there are large variations in metabolic rates. For example, coldblooded animals have rates that fluctuate, depending on the surrounding temperature. In hot surroundings, metabolic rates are high; they are low in cold surroundings. On the other hand, warmblooded animals have a constant body temperature and therefore a fairly constant metabolic rate. However, warmblooded animals that are hibernating have low metabolic rates due to their lowered body temperatures.

CHAPTER 7

1. Describe three aspects of respiration that all aerobic organisms have in common. Then describe four different mechanisms of gas exchange, mentioning specific organisms as examples.

Chapter 7 continued

All aerobic organisms exchange the same two gases: oxygen and carbon dioxide. During cellular respiration oxygen is taken into the cell and carbon dioxide leaves the cell. The gases move across cell membranes by dissolving in liquids. This means that membranes must be moist for gas exchange to occur. In addition, the gases move by the process of diffusion, from an area of higher concentration to an area of lower concentration.

In one-celled organisms such as the paramecium, and in some simple multicellular organisms such as the hydra, there are no special respiratory organs. Oxygen and carbon dioxide simply move across cell membranes depending on the concentrations of the gases on either side of the membranes. Other relatively simple organisms, such as earthworms, accomplish gas exchange through their skin. The gases diffuse through the moist skin into or out of the bloodstream, which carries gases to and from all the cells of the body.

Other, larger multicellular organisms have special respiratory organs that function in gas exchange. For example, fish and other water-dwelling organisms have gills. Oxygen dissolved in water passes over the gills and diffuses into the bloodstream at the same time that carbon dioxide diffuses from the blood through the gills into the water. Humans and many other animals have lungs composed of millions of tiny air sacs. Gas exchange takes place by diffusion between air sacs and nearby capillaries.

Plants have openings in their leaves, called stomates, and in their stems, called lenticels, which allow gases to diffuse between plant and air.

2. Describe the pathway of gas exchange in humans, beginning with entering the lungs, then going to a cell, and finally, coming back to the lungs. Note the mechanisms involved at each point of gas exchange.

When a person inhales, the tiny air sacs or alveoli in the lungs fill with air. Since the alveoli have a higher concentration of oxygen than the concentration in nearby capillaries, the oxygen diffuses from the alveoli into the bloodstream. Here the oxygen bonds with hemoglobin forming oxyhemoglobin. The blood travels throughout the body and when it passes a cell with a low concentration of oxygen the oxyhemoglobin breaks apart, releasing oxygen, which diffuses into the cell.

At the same time, carbon dioxide, which has become concentrated inside the cell due to cellular respiration, diffuses into the bloodstream. The carbon dioxide is then carried in the blood back to the alveoli in the lungs. Since the concentration of carbon dioxide is higher in the blood than in the alveoli, it diffuses into the alveoli and is eventually exhaled through the lungs.

CHAPTER 8

1. In a short essay on the process of digestion, include a definition of digestion, an explanation of the primary function of digestion, and a description of the types of digestion

(mechanical/chemical and intracellular/extracellular). Include examples whenever possible.

Digestion is the process of breaking down ingested food into smaller particles. In multicellular organisms this is an important function because only very small food particles can be used by individual cells. As a result of digestion, cells are able to use food for energy or for building and repairing cell structures.

In most consumers, two types of digestion can be distinguished: mechanical and chemical. Mechanical digestion refers to breaking food into smaller pieces by mechanical means. Examples of this would be chewing and mashing by teeth, or grinding by a gizzard. On the other hand, chemical digestion breaks food into smaller pieces by breaking chemical bonds between the subunits of food molecules. For example, enzymes break down starch molecules into smaller sugars.

Digestion can also be classified as intracellular or extracellular depending on where it occurs in an organism's body. Simple organisms such as paramecia break down food inside the cell; this is termed intracellular digestion. Other organisms, for example grasshoppers and humans, break down food in a cavity outside individual cells; this is termed extracellular digestion.

2. Trace a bite of a ham sandwich, with mayonnaise, lettuce, and tomato slice, through the entire human digestive tract. Explain (a) what happens in each major organ, (b) where each food group is digested, (c) what types of enzymes are involved in digestion, and (d) what the final products of digestion are.

In the mouth, the piece of ham sandwich is mechanically broken down by chewing with teeth. Chemical digestion of carbohydrates begins as the enzyme amylase found in saliva breaks down starch in the bread. The food next enters the esophagus, a tube connecting the mouth with the stomach. No enzymes are secreted in the esophagus. Once in the stomach, the food is mixed with hydrochloric acid, which helps break it into finer particles. A protease secreted by the stomach begins to break down proteins in the ham. The partially digested food leaves the stomach and enters the small intestine, which secretes enzymes and also receives enzymes from the pancreas, and bile secreted by the liver. Every sort of enzyme (carbohydrate enzymes, proteases, lipases, nucleases) is found in the small intestine. The carbohydrate enzymes continue to break carbohydrates down into their final end product, simple sugars. Proteases complete digestion of proteins and convert them into amino acids. The lipases break down fats into fatty acids and glycerol. Nucleases break down nucleic acids into their component parts of sugar, phosphate groups, and nitrogen bases. These digested nutrients are absorbed into the bloodstream in the small intestine. Undigested material next enters the large intestine. The function of the large intestine is to reabsorb water, vitamins, and minerals and collect undigested material, which eventually is egested through the anus.

CHAPTER 9

1. List and explain five mechanisms by which substances are transported at the molecular level from one place to another in organisms. Give an example for each mechanism.

Processes by which substances are transported in organisms from place to place include diffusion, osmosis, active transport, endocytosis, and exocytosis. Diffusion occurs when a substance moves from a place where it is more concentrated to a place where it is less concentrated. Diffusion is a passive process, meaning that it requires no energy expenditure by the organism. An example of diffusion is the movement of oxygen from alveoli in the lungs into blood capillaries. Osmosis is a special case of diffusion because it refers only to the movement of water across a semipermeable membrane. During osmosis, water moves into or out of a cell, depending on where the concentration of water molecules is the greatest. Soil water moves into root cells because the water in the root cells is less concentrated than soil water. Osmosis is also a passive process.

The above transport mechanisms are examples of passive transport. In the case of active transport, substances are moved from an area of low concentration to an area of higher concentration, a process which requires the expenditure of energy. An example of active transport is the movement of sodium ions across membranes in the human body.

Carrier molecules are sometimes involved in transporting substances—either actively or passively. Carrier molecules attach to substances and facilitate their movement to an area of lower concentration (passive transport) or to an area of higher concentration (active transport). For example, carrier molecules are involved in the transport of glucose from the blood into cells.

Two other mechanisms involved in transport of substances are endocytosis and exocytosis. In endocytosis the cell membrane surrounds the substance—often particles or large molecules—and pinches off to form a vacuole inside the cell. An example of endocytosis is the formation of a food vacuole in an amoeba. The opposite mechanism, exocytosis, involves transport of substances out of a cell. In exocytosis substances contained within a vacuole are carried to the cell membrane, where the vacuole fuses with the cell membrane and substances are expelled. An example of exocytosis is the secretion of digestive enzymes in the pancreas.

2. Compare and contrast the transport system in vascular plants with the system in complex animals. Base your answer on the three features common to all transport systems.

The three features of any transport system are: 1) they move materials in a liquid; 2) they move the liquid and materials in specialized tubes; and 3) they have a mechanism for moving the liquid and materials. Vascular plants and complex animals share these three features but differ in specific components. For example, plants move minerals, food, and water in a

Chapter 9 continued

watery substance (sap), which is similar to the watery substance in animals (blood). However, blood contains living cells and carries respiratory gases in addition to food and water.

Plants transport substances through specialized tubes called xylem and phloem. Complex animals transport materials through blood vessels and lymph vessels. There are three types of blood vessels—arteries, veins, and capillaries—which differ from each other anatomically and functionally. The blood vessels in animals can change shape and can affect the rate of blood flow, whereas plant vessels are rigid and have no effect on flow regulation. The mechanisms used to transport substances throughout the body of a plant are quite different from the basic mechanism in animals. In plants a combination of three forces—root pressure, capillarity, and cohesion-tension—are at work. In animals, the pumping force created by the regular contractions of the heart muscle is the main transport mechanism.

CHAPTER 10

1. Describe the basic function of excretion and outline the four basic steps of excretion in complex organisms. Use the human excretory system as an example and describe where carbon dioxide, water, and nitrogenous wastes are produced. Mention the main products excreted and the excretory organs involved.

Excretion is the process of removing wastes from an organism's body. Excretion also functions to maintain the balance of salt and water in an organism. Since most wastes are produced in individual cells, the first step of excretion is to remove wastes from the cells themselves. The wastes are then transported via blood to the main organs of the excretory system, where they are filtered out of the transport system. Finally, wastes leave the body altogether.

In humans, carbon dioxide and water are produced in cells during cellular respiration. Carbon dioxide is expelled through the lungs during breathing. Some water is always excreted through the lungs as water vapor during breathing. Depending on the amount of water reabsorbed into the body, excess water is excreted in the urine. Nitrogenous wastes are produced when liver cells break off the amino group from amino acids, forming ammonia, which is converted to urea. Urea is filtered out by the kidneys and leaves the body in urine through the urethra. Some excess salts are excreted by the skin in the form of perspiration or are filtered out by the kidneys.

2. Explain the processes or mechanisms involved in the excretion of nitrogenous wastes, carbon dioxide, and excess water in any three of the following organisms: plant, paramecium, earthworm, grasshopper, human.

Plants do not normally use amino acids for energy and therefore produce no nitrogenous wastes. The carbon dioxide produced from respiration is used in photosynthesis to produce glucose; at night, the carbon dioxide is excreted from the plant. Oxygen

Chapter 10 continued

produced during photosynthesis that is not used for cellular respiration is also excreted. Excess water is either used in photosynthesis or is lost through the leaves during transpiration.

A paramecium removes ammonia and carbon dioxide through the simple process of diffusion. The excess water that enters a paramecium is pumped out by contractile vacuoles.

In the earthworm, nitrogenous wastes diffuse from the cells into the body fluids. Excess water also diffuses into the body fluids. From body fluids, these materials enter nephridia where they are filtered out. Wastes pass from nephridia to the skin through ducts and out of the body through pores. Carbon dioxide is transported in the blood to the skin, where it diffuses out of the body.

The carbon dioxide produced in a grasshopper's cells diffuses into the body fluids and then is absorbed into the tracheas. From there the carbon dioxide diffuses out through openings called spiracles. The uric acid formed in the cells also diffuses into the body fluids and is actively transported into the Malpighian tubules. In the tubules uric acid is changed into uric acid crystals. These enter the digestive tube and leave the body through the anus. The water produced in cells diffuses into the Malpighian tubules and is mostly reabsorbed.

In humans, the carbon dioxide produced during cellular respiration diffuses into the blood, where it is carried to the lungs. Here it diffuses from the blood into the alveoli of the lungs and then is exhaled. Nitrogenous wastes produced in the liver diffuse into the blood stream as urea. Urea is carried to the kidneys, which filter the wastes from the blood. Urea, water, and other wastes mix to form urine and leave the body through the urethra. Water formed in cells diffuses into the body fluids and then into the blood. Excess water in the blood is removed by the kidneys and leaves the body in the urine.

CHAPTER 11

1. In a short essay, present an overview of movement. Your discussion should mention what the term *movement* includes and what the functions of movement are. Also, briefly discuss the structures or mechanisms for movement found in unicellular organisms, plants, and animals.

Movement refers not only to how an organism gets from place to place, called locomotion, but also refers to the movement of cells or body parts involved in basic life processes. Being able to move from place to place enables an organism to find food, shelter, and mates; to communicate; and to escape from predators.

Unicellular organisms accomplish locomotion using one of three structures: cilia, flagella, or pseudopods. Plants are only capable of limited locomotion. However, individual parts, for example, stems or leaves, can move due to unequal growth or turgor pressure changes in cells. Simple animals, such as the hydra, possess contractile fibers, which contract to move the body. Other, more complex animals, such as earthworms, insects, and vertebrates, have muscles that contract to move the body. In many animal

species muscle action is aided by an internal or external skeleton.

2. In a human being, three organ systems—skeletal, muscular, and nervous—work in concert to make voluntary movement from one place to another possible. Describe the structural components of the skeletal and muscular systems and briefly explain how each of the three systems works to achieve voluntary movement.

In humans, the skeletal system consists of an endoskeleton composed of cartilage and bone. Cartilage is made of cells surrounded by a matrix of polysaccharides and protein fibers. Bone, in contrast, is composed of cells surrounded by a hard, mineral-containing matrix. Bones are thus rigid, while cartilage is flexible. The skeleton is important to locomotion because it functions as a rigid framework against which muscles pull.

The muscular system is composed of three types of muscle: skeletal, smooth, and cardiac. Each type differs structurally and functionally. Skeletal muscle, involved with moving the skeleton from place to place, is composed of numerous muscle cells, or fibers. Generally, each end of a muscle is attached to two different bones. Depending on the arrangement, when the muscle contracts, it causes the bones to bend toward one another or away from each other. Each muscle can only cause two bones to move with respect to each other. Thus, muscles work in pairs to achieve all possible skeletal movements.

The nervous system is involved in generating and carrying a nerve impulse to a skeletal muscle. The nerve impulse initiates muscle contraction which results in movement. The nerves to skeletal muscles are under conscious control. As a result, movement of skeletal muscles is voluntary.

CHAPTER 12

1. Briefly explain what hormones are. For plants and animals, describe (a) where hormones are produced, (b) how they are distributed, and (c) what kinds of functions they perform. Give examples where possible.

Hormones are chemicals found in plants and animals that regulate various biological processes. In plants, hormones are made in specialized cells and are transported to other cells either in the vascular tissue or by diffusion or active transport. Plant hormones are involved in cell division, cell elongation, fruit ripening, flowering, and leaf fall.

Animal hormones are produced in specialized cells, collectively called a gland, and are carried in the blood throughout the body. Only the target organ has receptor molecules that recognize and combine with the hormone. When the hormone reaches its target and combines with the receptor molecule, it causes a response in the target cells. For example, when the hormone glucagon combines with the receptors in liver cells, it stimulates those cells to convert glycogen to glucose.

Animals produce a large number of hormones that function in many life processes. Hormones are involved in regulating the rate of cellular respiration, growth of the skeleton, reabsorption of water by the kidneys, digestive processes, reproduction, and other important body functions.

2. Briefly explain the feedback mechanism involved in regulating production of one of the following hormones: thyroxine, follicle stimulating hormone (FSH), or parathyroid hormone (PTH).

The feedback mechanism that keeps a steady amount of thyroxine in the blood involves the hypothalamus, the pituitary gland, and the thyroid gland. In response to lowered levels of thyroxine in the blood the hypothalamus produces TRF which stimulates the pituitary gland to secrete TSH. When TSH reaches the thyroid gland, it stimulates it to produce thyroxine. When the concentration of thyroxine in the blood increases, the hypothalamus responds by reducing its production of TRF, which slows production of TSH which slows production of thyroxine. In turn, increased levels of thyroxine cause the hypothalamus to reduce production of TRF, causing the pituitary to reduce production of TSH. Lowered levels of TSH cause the thyroid gland to decrease production of thyroxine.

During the menstrual cycle, follicle-stimulating hormone secreted by the pituitary stimulates an egg cell and a follicle in the ovary to begin to develop. As they mature, the follicle cells begin to produce estrogen. When the concentration of estrogen in the blood reaches a certain level, the estrogen causes the pituitary to stop secreting FSH. This, in turn, keeps other egg cells and follicles from developing. Following menstruation, the corpus luteum disintegrates and stops producing progesterone. As the level of progesterone is lowered, the level of LH also decreases, causing the pituitary to increase production of FSH as the cycle begins again.

Parathyroid hormone stimulates the release of calcium from bones. When the concentration of calcium reaches a certain level in the blood, it causes the parathyroid glands to cut back in production of PTH. As calcium is used by the body and calcium level in the blood drops, the parathyroid glands are signalled to produce more PTH, causing calcium to be released into the blood.

CHAPTER 13

1. Write a short essay on neuron function. Describe the resting state of a neuron and how a nerve impulse is initiated when a dendrite receives a stimulus. Then explain how the impulse travels and how it is transmitted to a second neuron.

A neuron that is in its resting state is negatively-charged inside the cell with respect to the outside of the cell. If a stimulus is strong enough, it will momentarily change the permeability of the neuron membrane at the point of stimulation. Ions begin to

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move across the cell membrane of the dendrites at that point, reversing the charges on each side of the membrane. This movement, in turn, changes the permeability of adjacent points on the membrane. Thus, the impulse moves along the dendrites through the cell body and then along the axon. When the impulse gets to the end of the axon it causes the release of a transmitter substance from sacs in the synaptic knob. The transmitter substance crosses the synapse and binds with receptor molecules in the dendrites of the second neuron. This event affects the permeability of the membrane of the second neuron to ions transmitting the nerve impulse to the second neuron.

2. In a short essay, explain the relationship among the parts of the human nervous system listed below. Also briefly describe the structure and function of each part of the nervous system (autonomic nervous system, central nervous system, parasympathetic nervous system, peripheral nervous system, sympathetic nervous system, somatic nervous system)

The human nervous system can be divided into the central nervous system and peripheral nervous system. The central nervous system consists of the brain and spinal cord. The brain is extremely complex and various parts of it function to control voluntary muscle movements, sense perception, thinking, actions, muscle coordination, and vital organs. The spinal cord carries impulses between the brain and the body and is also involved with body reflexes.

The peripheral nervous system includes all neurons outside the central nervous system. The peripheral nervous system can be divided into the somatic nervous system, which consists of nerves that control voluntary actions, and the autonomic nervous system, which consists of nerves that control vital organs. In turn, the autonomic nervous system is composed of the sympathetic and parasympathetic nervous systems. These two systems have different transmitter substances, and different locations of ganglia. They both function to control body organs such as the heart, lungs, and intestines, working in opposite ways to either speed up or slow down a process.

CHAPTER 14

1. In a general way describe how stimuli in the external world are perceived by an organism. Give two examples of the relationship between an organism's perceptions and its way of life or survival.

In order to be perceived by an organism, stimuli, such as light, temperature, or sound must first cause a response in an organism's receptors. If an organism does not have a receptor for detecting a particular type of stimulus, that stimulus will never be perceived. In cases in which organisms do have receptors, the stimulus causes a change in the receptor. Sometimes, the interaction results in a chemical change in the receptor; in other cases the receptor is changed

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mechanically. The change in the receptor generates a nerve impulse, which travels to a particular area in the brain. Within the brain the impulse is translated into a perception. The senses commonly perceived by animals include heat, cold, pain, sight, hearing, taste, touch, and smell.

One example of the relationship between an organism's perception and survival is the detection of ultraviolet light by bees. Bees communicate the location of food to other hive members by using the sun as a reference point. Ultraviolet light is important to the survival of the hive when clouds conceal the sun and only ultraviolet rays are able to pass through to the ground. Another example is the detection of water currents by means of receptors located along the lateral line in fish. This ability helps them locate prey and avoid predators.

2. In your own words, describe the process of hearing in humans, mentioning the important structures involved and their functions.

Sound waves in the air enter the external ear and are conducted through the auditory canal to the eardrum (tympanic membrane). The sound waves cause the membrane to begin vibrating. Then the vibrations are conducted through the bones of the middle ear: the hammer, anvil, and stirrup. The stirrup is connected to the oval window, which is part of a fluid-filled tube in the inner ear, the cochlea. When the oval window vibrates, it causes the fluid inside the cochlea to move in waves. The waves of fluid exert pressure on receptor cells known as hair cells located within the cochlea. The hair cells generate nerve impulses, which travel to the portion of the brain involved with hearing. It is here that the impulses are translated into the perception of sound.

3. Contrast the structural and functional differences among the four types of photoreceptors found in the animal kingdom. Include examples of animals in which each type of photoreceptor is found.

The simplest photoreceptor is an eyespot, which consists of light-sensitive pigment molecules. These pigments change in the presence of light. However, eyespots do not have lenses and are therefore incapable of forming an image or detecting movement. Eyespots are found in planaria.

Simple eyes, found in many arthropods, possess a lens that focuses light on receptor cells. Simple eyes can form crude images and detect movement.

Insects have compound eyes, which are made up of many individual ommatidia, each having a lens. Each lens focuses light on photoreceptor cells, which form fuzzy images but can instantly detect movement.

The vertebrate eye is unique in that the single lens is capable of changing shape in some animals or moving in others. The lens focuses light onto receptor cells which send impulses to the brain. The mechanism of vision in vertebrate eyes is similar to the way a camera works. Both involve an adjustable lens that focuses light onto a light-sensitive surface, causing an inverted image to be produced. The vertebrate eye can form sharp images and detect movement. Many

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animals, including humans, possess light receptor cells for color as well as black and white vision.

CHAPTER 15

1. In a short essay, explain what DNA, chromosomes, and mitosis are and how they are related to one another.

DNA, or deoxyribonucleic acid, is a nucleic acid. The DNA molecule is composed of nucleotides that each consist of a simple sugar, a phosphate group, and a nitrogen base. Molecules of DNA are found within chromosomes located in all living cells. DNA is unique in its ability to replicate itself. DNA contains information for all the traits of an organism by coding for the manufacture of proteins.

Chromosomes are structures composed of DNA and protein molecules. Because chromosomes contain DNA, they are the organelles concerned with the inheritance of traits.

Mitosis is the process by which a cell's nucleus replicates and divides during cell division. Mitosis is closely related to DNA and chromosomes because during mitosis replicated chromosomes are separated into separate nuclei. As a result of mitosis, two nuclei, each having the same chromosomes, and thus identical DNA, are produced.

2. How can a chemical code stored in DNA determine physical traits or cell functions? Mention protein synthesis and enzymes in your discussion.

The chemical code refers to the sequence of bases found in a DNA molecule. A specific sequence of three bases on DNA codes for a particular amino acid. The pattern of three-base sequences on a piece of DNA determines the order in which amino acids will be joined during the process of protein synthesis. In this way, the DNA base sequence codes for particular proteins to be manufactured by a cell.

Many parts of a cell are made of protein. Depending on how much or what kind of proteins a cell makes, the proteins are used to build cell organelles or other structures. Some proteins become part of enzymes, which act in controlling the cell's functions by regulating the rates of chemical reactions in the cell.

CHAPTER 16

1. Contrast asexual and sexual reproduction. In your essay, discuss differences in the amount of variation found in the offspring resulting from each type of reproduction. Include the roles of mitosis and meiosis in your explanation.

Asexual reproduction refers to various ways of producing new individuals from only one parent. For example, a piece of one parent plant (a cutting) can grow into a new individual plant. Another type of asexual reproduction is found in protists, which divide by mitosis to form two new individuals both with

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identical genetic material. All the offspring of asexual reproduction are clones of the parent organism.

In contrast, sexual reproduction involves the union of two specialized sex cells, or gametes that are produced by a special type of cell division called meiosis. Meiosis involves two divisions of genetic material, resulting in four haploid cells having half the normal number of chromosomes. The haploid cells differentiate into gametes that each carry a different set of genetic information. Gametes join to form a zygote, the initial cell of a new individual. Usually the gametes come from two separate parents. Offspring formed by the union of gametes are different from either of the parents. Thus, there is a high degree of variation in offspring resulting from sexual reproduction. On the other hand, offspring resulting from asexual reproduction are identical to the parent organism and lack any variation.

2. What is meiosis? Outline the basic events of meiosis and explain its importance to the process of sexual reproduction.

Meiosis is a special type of cell division that occurs only in the reproductive organs of plants and animals. During the process of meiosis a parent cell divides twice, which reduces the chromosome number in each resulting cell to one half the original number. Thus, meiosis results in the formation of haploid gametes or spores.

Before meiosis occurs, chromosomes replicate and become double-stranded. Homologous pairs of chromosomes come close together and form tetrads (groups of four chromatids). Next, pairs of homologous chromosomes line up in the middle of the cell and the pairs separate and move to the opposite poles of the cell. The cell then divides, forming two cells containing double-stranded chromosomes. During the second meiotic division the double-stranded chromosomes line up in the middle of each cell, and chromatids separate and move to the opposite poles of the cells. Each cell divides, resulting in four haploid cells.

The fact that the cells are haploid is crucial to the process of sexual reproduction. Since each reproductive cell contains only one half the normal number of chromosomes, the union of two of these cells at fertilization results in a zygote having the normal number of chromosomes. If a reduction of chromosome number did not occur, each instance of fertilization would result in an individual with double the number of chromosomes found in either of the parents.

CHAPTER 17

1. What is meant by "alternation of generations" in plants? Outline the life cycle of either a moss or fern plant to illustrate this concept. In your essay also include an explanation of the concept of dominant generation.

"Alternation of generation" refers to the life cycle of plants, which alternate between sporophyte and gametophyte generations. They reproduce sexually in one generation and asexually in the next. For example, the moss plants that are easily visible are

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members of the gametophyte generation. Since this generation is most noticeable, it is called the dominant generation. The gametophyte is haploid and the plants produce eggs and sperm by mitosis. The sperm from one moss gametophyte swim to the egg on another moss gametophyte and fertilization takes place. This results in a diploid zygote growing out of the gametophyte that develops a long stalk with a capsule on the end. This structure is the sporophyte generation. Within the capsule, meiosis occurs and haploid spores are produced. These spores spill onto the ground and will develop into new haploid gametophyte plants.

For example, the fern plants that are easily visible represent the sporophyte generation of the fern. Since this generation is most noticeable, it is called the dominant generation. The sporophyte is diploid. The sporophyte plants produce capsules, or sporangia, on the undersides of their leaves. Within the sporangia, meiosis takes place and haploid spores are formed. When these spores land on the ground they develop into tiny plants, which represent the gametophyte generation. The gametophytes produce eggs and sperm in female and male reproductive organs. The sperm swim to the eggs and fertilize them, forming diploid zygotes. The zygotes then develop into new sporophyte plants.

2. In flowering plants, meiosis takes place in reproductive organs and results in haploid gametes. Outline the process of gamete formation and the double fertilization that takes place in a flowering plant.

In a flowering plant gametes are formed by meiosis in either the male reproductive organ (the stamen), or in the female reproduction organ (the pistil). The anther produces pollen grains which are transferred to the stigma. Each pollen grain forms a pollen tube, which travels down the stigma to the female ovary and releases two sperm cells. Within the ovary are ovules that each produce female spores. Three of the four spores produced by meiosis die, leaving one spore that divides to form an embryo sac containing seven cells, one of them an egg cell. As the sperm move down the pollen tube they enter the embryo sac. One sperm unites with the egg to form a diploid zygote. A second sperm unites with the other nuclei in the embryo sac to form a large cell with three haploid sets of chromosomes that forms endosperm. Thus, double fertilization has taken place.

CHAPTER 18

1. Answer the following questions about human reproduction: Where are male and female gametes formed? How often are they formed? Trace the paths of sperm and eggs from their origin to the site of fertilization.

Sperm are produced in the two male reproductive organs, which are called testes. A testis contains a long series of tubes called seminiferous tubules. The cells that line the tubules undergo meiosis to form sperm. This process begins at puberty and continues

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throughout a man's life. Sperm travel from the seminiferous tubules through a tube called the vas deferens into the urethra. The urethra is a tube through which sperm travel through the penis to the outside of the body.

The female produces eggs in two reproductive organs called ovaries. The ovaries contain many immature eggs when the female is born. About once a month, from puberty to menopause, one immature egg matures within a follicle and ruptures out of the ovary. After ovulation the egg travels down the oviduct.

Sperm deposited in a woman's vagina swim up through the cervix and uterus and into the oviduct. Within the oviduct fertilization takes place as a sperm penetrates an egg cell.

2. Briefly describe the major events in the life of a human embryo from fertilization through birth. Mention layers of tissue that form during development and briefly describe the birth process.

Many events take place in changing the one-celled zygote into a baby in nine months. The fertilized egg, or zygote, first begins a period of cell division, or cleavage as it travels down the oviduct into the uterus. Six days after fertilization, it attaches to the uterine wall and the embryo is a hollow ball of cells, the morula. The morula travels to the uterus and becomes a fluid-filled ball of cells, the blastula. The single cell layer of the blastula folds over to form the pouchlike gastrula, made of two cell layers, the ectoderm and endoderm. Eventually a third, middle layer of cells forms, the mesoderm. From that point, layers of cells differentiate and begin to develop into specialized tissues and organs. An organ made up of the chorion membrane of the embryo and cells of the uterus develops near the embryo and is called the placenta. The maternal blood and fetal blood come into close contact in the placenta and exchange food, oxygen, and wastes. During the entire pregnancy the fetus' organs become fully developed and the fetus gains weight and length.

At the end of nine months, labor, or the process of childbirth, begins. Contractions of the uterine wall push the fetus down toward the cervix. The amniotic sac around the baby breaks. The cervix dilates and forceful contractions of the uterus and abdominal muscles push the baby out through the vagina. The placenta, amniotic sac, and other fluids pass through the vagina shortly after the baby's birth.

CHAPTER 19

1. Define the following terms used in genetics and explain how they are related to one another: genotype, homozygous, heterozygous, phenotype, environment.

Organisms that result from sexual reproduction inherit one set of chromosomes from each parent. Since there are two sets of chromosomes, there are also two sets of genes. The combination of genes involved in determining physical traits is known as

the organism's genotype. If two genes code for the same expression of a trait, the genotype is said to be homozygous; if the genes code for different expressions of the trait, the genotype is said to be heterozygous. For example, if T represents the gene for tall and t represents the gene for short, the genotypes TT and tt are homozygous; Tt is heterozygous.

Phenotype refers to the visible expression of traits, such as hair color, wavy or straight hair, or height. Genotype is related to phenotype because genes control what proteins or enzymes are synthesized. As a result the phenotype is largely determined by the genotype. The environment also interacts with the genotype, and in some cases alters the phenotype so that it does not reflect the actual genotype.

2. In four o'clock plants, when homozygous, red-flowered plants (RR) are crossed with homozygous white-flowered plants (rr), the resulting offspring have pink flowers. Explain briefly what has occurred to cause the pink flowers. Which of Mendel's laws of inheritance does NOT apply in this type of inheritance? Why not?

This is a case of incomplete dominance. In incomplete dominance, the effects of two different genes for a trait, when inherited together, seem to blend in the phenotype of the offspring. As a result, red and white effects "blend" to create pink flowers. This type of inheritance is an exception to Mendel's law of dominance. According to the law of dominance the dominant expression of a trait is always seen in heterozygous offspring because the recessive trait remains hidden. In four o'clocks, the terms *dominant* and *recessive* do not apply in the inheritance of flower color, since neither red nor white flowers are seen in heterozygous offspring.

CHAPTER 20

1. Define *sex-linked trait*. If a man has a recessive sex-linked trait, will either his male or female children have a chance of inheriting the trait from him? Explain your answer.

A sex-linked trait is a trait, or phenotypic expression of a gene, that is directly linked to the sex of the organism possessing the trait. Genes for sex-linked traits are recessive and are carried on the X chromosome. Males have a sex chromosome genotype of XY, and therefore any sex-linked trait (dominant or recessive) will be expressed phenotypically since there is only one X chromosome. During meiosis in males, the X and Y chromosomes separate and go into individual sperm cells. Thus, a man possessing a sex-linked trait on the X chromosome passes on this chromosome, and trait, in half his gametes. If a sperm containing this X chromosome fertilizes an egg with an X chromosome, the resulting female offspring will have inherited a gene for the recessive trait from her father. The daughter will only show the recessive trait if she also inherited the recessive gene from her mother. On the other hand, if a sperm containing a

Y chromosome fertilizes an egg, the resulting male will not have inherited the sex-linked trait from his father. The son will manifest the recessive trait only if he inherits an X chromosome with the recessive gene from his mother.

2. Explain, in terms of the DNA code and the synthesis of hemoglobin, what causes sickle-cell disease.

Sickle-cell disease is a blood disease caused by a gene mutation that produces an abnormal polypeptide chain in the hemoglobin molecule. The hemoglobin molecule is made up of four polypeptide chains, which are composed of amino acids arranged in a particular sequence. The order of amino acids is coded for by the sequences of bases on DNA. Three consecutive bases on DNA code for a particular amino acid. If one base is changed in some way, the resulting triplet could code for an entirely different amino acid. This is the case in sickle-cell disease. At some point a base in the genes coding for hemoglobin synthesis probably underwent mutation, resulting in a gene coding for abnormal hemoglobin. The mutated gene is expressed as sickle-cell disease in a person who inherits it. Thus, a change in one base in DNA changes one amino acid in the polypeptide chain. This change, in turn, changes the shape of the hemoglobin molecule and results in sickle-cell disease.

CHAPTER 21

1. Describe three types of evidence that support the idea that species are related to one another through common ancestors in the past. Include examples.

Evidence of common ancestry among species may be provided by fossil evidence of organisms that lived in the past and may be extinct now. In addition, living organisms provide evidence of relatedness because of similarities in anatomy and physiology.

Fossil clues suggest relationships among groups of organisms. For example, *Archeopteryx*, a fossil bird, has characteristics of reptiles and birds. These similarities lead scientists to believe that reptiles and birds are related.

Looking at the anatomy of living organisms, homologous structures also support the idea that various species are related. For example, many vertebrates have similar bones in their limbs, supporting the idea that they have a common ancestor. The human arm, wing of the bat, and fin of the whale are homologous structures. The study of embryo development supports the idea of common ancestry. Many embryos go through similar stages of development, which implies they may be related to one another ancestrally. The presence of vestigial organs is also a clue to common ancestry. Some species have structures or organs, such as traces of legs in snakes and whales, that are no longer functional, while the same structures are still functional in other species.

Another basis for comparison is chemistry of the body. The fact that all living things possess DNA and that some species share the characteristic of possessing

hemoglobin or chlorophyll molecules gives support to the idea that all species are interrelated.

2. Explain Darwin's and Wallace's theory of natural selection. Describe the major points of the theory and cite one example that supports their idea.

The theory of natural selection states that species change over time because environmental conditions select well adapted organisms to survive and pass on their genes to the next generation. In the natural world, there is a struggle for existence because resources are limited, and many more organisms are born than can be supported by the available resources. Organisms possess many variations. These variations affect how well-adapted or well-suited an organism will be to its environment. Those organisms with favorable variations will survive and reproduce. If they manage to reproduce, their traits will be passed on to the next generation. In this way species can change over time as new variations are favored by natural selection.

An example of this sort of change is seen in the case of the peppered moth. As an environment that favored light-colored moths became polluted, more and more dark colored moths (better adapted for the effects of pollution) were found in the population.

CHAPTER 22

1. In a short description of energy flow through living systems, explain how the following concepts are related: sun, producer, consumer, decomposer, food, food chain, energy loss.

The source of energy for living systems is the sun, which provides energy in the form of light. When light energy reaches plants and algae, some of it is converted to chemical energy by photosynthesis. The chemical energy is stored by plants in the form of glucose, starch, and other nutrients. Since they can produce their own food, plants and algae are called producers.

Producers are eaten by various types of primary consumers (herbivores) that utilize the energy stored in producers for their own life activities. Herbivores are eaten by secondary consumers (carnivores) who use the energy stored in the herbivores for their own body processes. The organisms involved in this transfer of energy from one organism to another are said to be in a food chain. Another type of consumer, decomposers, feed on dead organisms and waste products of living organisms. As they do, they use some of the energy in the dead bodies and wastes and release much of the stored energy as heat.

Energy is lost in all energy transfers. For example, an herbivore that consumes a plant does not receive 100 percent of the energy that was in the plant. Likewise, a carnivore does not receive 100 percent of the energy in an herbivore that is eaten. Some energy has been lost as heat produced during cellular respiration; some was used to maintain life functions in the herbivore.

2. Describe the five basic types of relationships between organisms of different species and give an example of each.

The five types of relationships found between organisms include mutualism, commensalism, competition, parasitism, and predation. In a mutualistic relationship both organisms benefit from being associated with one another. A termite and the protozoa that live in the termite's intestine have a mutualistic relationship. The termite provides food and the protozoa digest cellulose for the termite. Commensalism is a relationship in which one organism benefits and the other is unaffected. In the relationship between Gila woodpeckers and pygmy owls, the owls benefit by using the abandoned holes of the woodpeckers as nests, while the woodpeckers are unaffected.

Competition exists between two organisms that utilize the same resource. For example, hawks and owls both eat the same kinds of rodents and small mammals, so they are in competition for food resources. Parasitism involves a relationship in which one organism benefits and the other is harmed. Usually the parasite lives on or inside the host organism without killing it. For example, a tapeworm lives on food digested by the host animal, while the host suffers because it is not getting energy from the food it digests. In predation a predator organism kills and eats another living organism, the prey. Obviously this relationship does not benefit the individual prey, although it may keep the prey population healthy by preventing overpopulation. An owl catching and killing a mouse is an example of a predator-prey relationship.

CHAPTER 23

1. Name three factors in an ecosystem that are known to affect population growth and describe the effect each has on population size. Refer to birth rates or death rates when applicable.

Various factors in an ecosystem can have an impact on the growth of a population. These include the presence of competitive, or parasitic, predatory organisms, natural disasters, changes in climate, and the amount of waste products, food, or space in the surrounding environment. The presence of a competing species would have a negative effect on population growth. For example, if the competitor is eating the same food or claiming the same space, the original population may decrease in size due to increased death rate. The availability of food affects population growth in the same way; if a population uses resources faster than the resource can be replenished, the resulting food shortage will cause an increased death rate, which will reduce population size. Natural disasters, such as volcanic eruption, fire, or flood, reduce population size by causing many deaths over a short period of time. Changes in climate can affect population growth either by promoting reproduction through favorable conditions or by causing death of many individuals through unfavorable conditions. Crowding plays a role in population growth

causing some species to fail to reproduce if the population density gets too high.

2. Discuss what J-shaped and S-shaped curves indicate about population growth. In your answer, explain whether the curve represents a population in balance with its ecosystem.

When a population grows slowly at first and then rapidly over a short period of time the result is a J-shaped curve. In this situation, the conditions in the ecosystem are favorable to unchecked growth of the population. Thus, the population size increases rapidly. Eventually the ecosystem runs out of resources (food, space, etc.) and can no longer support the growing population. In this situation the population crashes. A population exhibiting this type of growth is not in balance with its ecosystem.

In contrast, a population that becomes established and achieves a state of balance with its ecosystem maintains a more stable size and does not deplete the resources in the environment. This type of population growth is characterized by an S-shaped curve. The curve has an S shape because population growth occurs rapidly at first and then levels off. As the population grows the resources of the environment are reduced. This, perhaps together with other factors, causes population growth to slow down. The population size that can be supported by an ecosystem over a long period of time is called the carrying capacity of that ecosystem. Once population growth levels off, the population size fluctuates around the carrying capacity.

CHAPTER 24

1. Briefly discuss the main factors that determine why a particular biome occurs in an area. Use a specific biome and its environmental conditions as an example. Include the relationship between climate and soil conditions and plant and animal communities in the biome.

In general, environmental characteristics, such as temperature, rainfall, and soil conditions, determine what plants will be able to live in an area. In turn, the plants that can grow in an area influence which animals will be able to survive there. For example, in high northern latitudes the average temperatures are cold, the rainfall is sparse and the soil is permanently frozen, except for the top layer, which thaws for a brief time each year. These conditions are not generally hospitable to life and only a few species of plants are able to tolerate cold, short days, a short growing season, and poor, shallow soil. In areas with these environmental conditions the vegetation is mostly made up of low-growth mosses and lichens, and has a characteristic appearance identifying these areas as tundra. Only those species of animals, such as caribou and lemmings, able to tolerate severe cold, and able to live on tundra plants can survive in the tundra. In summary, the plant life of an area is determined primarily by environmental conditions, while the

animal community is determined by a combination of climate and available food resources.

2. Explain the statement "Ecological succession cannot occur without dispersal." Include definitions of the terms *ecological succession* and *dispersal* in your explanation.

When the vegetation of an area goes through a series of systematic changes, ecological succession has occurred. Usually succession begins in an area that is relatively bare of vegetation (due to logging or natural disasters such as fire). The first plants to appear and begin growing are known as pioneers. As they die they add organic matter to the soil, which enriches the soil and enables other plant species to become established under conditions more favorable to their growth requirements. Each series of plant species modifies the environment in a way that makes it favorable for other species of plants and animals to survive in the area.

As an area passes through stages of succession, seeds of each new species of plant reach the area by means of dispersal. Dispersal refers to the spreading of organisms from one original location to new areas. As conditions in an area change and become favorable to the growth of new species of plants, the seeds germinate and a new stage of succession predominates. Without dispersal, new species of plants would never reach the area, preventing ecological succession from occurring.

CHAPTER 25

1. In a short essay describe two major differences between inherited and learned behaviors. Illustrate the differences with examples of each type of behavior.

Inherited behaviors are possessed by organisms at birth and may range from simple taxes and reflexes to the complex instincts found in many animals. Inherited behaviors cause an organism to respond in an innate or genetically programmed way upon perceiving a particular stimulus, the releaser. For example, a paramecium will swim away from chemical substances whether the encounter with chemical stimuli is its first or hundredth. Learned behavior, on the other hand, involves responses based on some previous experience with the stimulus. For example, in the behavior known as habituation an animal learns not to respond to unimportant stimuli in the environment. Newly hatched chicks crouch when an object passes overhead. If an object passes overhead many times without causing harm, the chick learns to disregard this object in its environment.

Another difference between inherited and learned behaviors involves the flexibility of the responses. For the most part, inherited responses are stereotyped and predictable. In the courtship behavior of stickleback fish, for example, actions of the male and female act as releasers to stimulate particular responses in the other sex. If the female did not respond to the male's behavior in a stereotyped way, the courtship behavior would cease. In learned behavior,

however, there is a great deal more flexibility possible in responses. For example, using the technique of operant conditioning, a behavior at first performed accidentally can be caused to be performed again by offering a reward for the behavior. Or, an animal can be taught to stop a behavior by ignoring or punishing the behavior. Using operant conditioning a caged rat can be trained to press a lever to release food, food being the reward that reinforces the behavior. In other words, the rat in this case is not behaving with automatic or instinctual responses to stimuli.

2. Discuss examples from either honeybee or baboon societies to support the statement, "Social behavior is advantageous to the protection, sustenance (food), and reproduction of a species."

By living in an organized group, individuals can perform different specialized jobs that benefit the group as a whole. This is more efficient than the situation in which each individual does all jobs. A good example of social organization is found in honeybees. The protection of all individuals in a hive is the task of the workers, who have stingers. After stinging an intruder, a worker dies, and her death benefits the rest of the hive. The workers also gather food for themselves, the young, the queen, and the males (drones). The queen and the drones are the only members of the colony involved in reproduction. The queen may lay hundreds of eggs a day, which would be impossible if she also had to defend or feed the colony.

Another example of an organism that benefits from social organization is the baboon. By staying together in a group, the weaker members of a group of baboons (young and females) can be protected by the stronger members (dominant males). Also, by banding in a group to gather food, all individuals are assured of something to eat. Within a troop of baboons, the males and females establish social dominance. The dominant animals mate with one another, which guarantees that their offspring will be strong and healthy. The result of this nonrandom mating is the perpetuation in the society of the traits most important to survival.

CHAPTER 26

1. The causes of disease can be broken into three major categories. Describe these categories and give one or more examples for each.

Diseases are caused either by malfunctions of the body, environmental factors, or disease-causing microorganisms (pathogens). There are many systems within the body that must function properly in order for a person to enjoy good health. If some part of the body is damaged or an organ malfunctions, a person becomes ill. For example, if the pancreas fails to secrete insulin in response to raised levels of sugar in the blood, the result may be *diabetes mellitus*, or if a person's genes code for a slight deviation from a normal hemoglobin molecule the result may be sickle-cell disease.

Some diseases are caused by substances in the environment that are taken into the body and have a harmful effect on body function. Some types of air pollution, for example, cause respiratory diseases. Environmental factors also include drugs and alcohol, which are taken into the body and can cause physical damage, for example, cirrhosis of the liver. Other diseases are caused when microorganisms enter the body and the individual is unable to resist them. Microbes include viruses, which can cause measles; bacteria, which can cause pneumonia or venereal diseases; protozoa, which can cause amebic dysentery; and others.

2. In a brief essay, summarize how the human body combats disease on its own, using three lines of defense. Give one example of how modern medicine contributes to the body's fight against disease.

There are three lines of defense used by the body to combat pathogens. First, cilia and mucus cover the lining of some of the tracts in organ systems. Both of these help trap and eliminate foreign particles from the body. Other substances produced by the body, including tears, saliva, and hydrochloric acid, help destroy harmful bacteria.

If physical barriers are not effective, certain white blood cells seek out and kill bacteria that enter the bloodstream or tissues. These white blood cells are the second line of defense. Other white blood cells, known as lymphocytes, make up the third line of defense. Lymphocytes recognize particular antigens and produce specific antibodies to destroy them when they enter the body.

Modern medicine has developed drugs to help combat various pathogens. For example, antibiotics are a group of fungi-derived drugs that kill various species of bacteria. Medical techniques have been developed to fight diseases caused by body malfunctions. For example, organ transplants, artificial kidney or lung machines, and artificial synthesis of hormones, can correct certain body malfunctions or substitute for organs no longer able to function efficiently.

FIRST SEMESTER EXAMINATION

1. All the different types of cells in the human body—skin, bone, muscle, nerve, blood cells, etc.—need sources of energy and oxygen and a way to eliminate metabolic wastes in order to stay alive and function. Describe the processes and body systems involved in meeting these needs of the body's cells.

In accomplishing each cell's basic needs, specialized organs for digestion, respiration, and excretion are involved. In addition, the circulatory system plays a key role in transporting substances to and from individual cells.

The main source of energy for most cells is glucose, a simple carbohydrate. When complex carbohydrates pass through the digestive system they are

broken into simple sugar molecules. These molecules diffuse into capillaries through villi in the small intestine and are carried in the bloodstream to all parts of the body. Glucose enters individual cells with the aid of a hormone called insulin. Once inside a cell, glucose and oxygen undergo a series of chemical reactions known as cellular respiration. During this process the chemical bonds of glucose are broken apart to yield carbon dioxide and energy. This energy is stored in molecules of ATP and can be used by the cell for any number of activities. The oxygen needed for cellular respiration is supplied to cells by blood capillaries as oxygen molecules released from hemoglobin in red blood cells diffuse into cells. Carbon dioxide, a waste product of cellular respiration, diffuses from the cells into blood capillaries.

The respiratory system includes organs that are responsible for getting oxygen into the bloodstream and carbon dioxide out. Oxygen is breathed into air sacs (alveoli) in the lungs. The air sacs lie close to capillaries and diffusion of oxygen takes place across the two membranes. Carbon dioxide excreted from cells and carried in the blood reaches capillaries in the lungs and diffuses into the air sacs. The carbon dioxide is breathed out during respiration.

Another cellular product, nitrogenous wastes in the form of ammonia, results from the breakdown of amino acids in the liver. Ammonia is toxic to cells and must be removed from the body. Ammonia is converted in the liver to urea which diffuses out of the liver cells into the bloodstream. When blood reaches the kidneys, nephrons filter urea and other wastes out of the blood and collect them in collecting tubules. Eventually the wastes, mixed with water and salts, reach the urethra and are excreted from the body as urine.

2. The concept of homeostasis is central to an understanding of the overall functioning of the body. Define *homeostasis*. Describe three examples of homeostasis and explain the mechanism involved in each. Include an example of a mechanism involving chemical feedback.

Homeostasis refers to the regulation of all body processes to maintain a balanced internal environment. This balance is dynamic because conditions are always changing and the body's mechanisms are continually adjusting to the changes. Some of the internal conditions that are regulated include the level of glucose, release of hormones, amount of minerals in the blood, cellular pH, body temperature, and relative amounts of salts and water.

The glucose level in the blood is regulated by two hormones produced by the pancreas: insulin and glucagon. Insulin lowers the glucose level by stimulating glucose uptake by cells. Glucagon has the opposite effect and increases the glucose level in the bloodstream.

Another hormone, thyroxine, regulates the rate of metabolism. Thyroxine affects the rate of cellular respiration, the reactions involved with synthesis and growth, and many other reactions taking place in cells. Regulation of thyroxine production involves a system of interaction known as a chemical feedback

mechanism. In this sort of system too little of a needed substance stimulates the production of a hormone that, in turn, stimulates the production of the needed substance. When the correct amount is present in the body, the production of the hormone ceases and this, in turn, stops the production of the hormone. The level of thyroxine in the body is controlled by a feedback mechanism involving the thyroid gland, the pituitary, and the hypothalamus.

Regulation of body temperature is another aspect of homeostasis. A constant body temperature is maintained in humans and other warmblooded animals by various mechanisms. The high body temperature is primarily maintained through the heat produced from metabolism. In the case of excess body heat the excretion of water through sweat glands cools the body through evaporation. By this mechanism excess heat is transferred from the body to the outside environment. If the body temperature cools, heat can be increased through increased activity that leads to a higher rate of cellular respiration.

3. What is the relationship between photosynthesis and cellular respiration? How are they similar and/or different? How are both processes important to all living things?

Photosynthesis is a series of chemical reactions that utilizes chlorophyll molecules, the sun's light energy, carbon dioxide from the atmosphere, and water from the environment to synthesize glucose molecules and produce oxygen. This process occurs only in algae and in plant cells that contain chlorophyll, which is able to capture light energy. The sun's energy is converted into chemical energy that is then stored in glucose molecules. Photosynthesis is important to all life because consumer organisms are not able to provide their own food. These organisms depend, directly or indirectly, on plants as their source of energy and raw materials for growth and repair.

Cellular respiration is a series of chemical reactions performed by cells of all living things, including plants. This process breaks down glucose molecules, releasing energy in the process. Cellular respiration requires oxygen and produces carbon dioxide as a waste product. Cellular respiration is critical to all cells because it releases the energy stored in glucose, making it available for use by cells. This energy is stored in ATP molecules, which cells use as they require energy for the chemical reactions involved in all life processes.

In summary, the raw materials needed for cellular respiration (oxygen and glucose) or photosynthesis (carbon dioxide and water) correspond to the products of the other process. These processes are also related because one stores energy in the form of glucose (photosynthesis), while the other releases energy from glucose molecules (cellular respiration).

SECOND SEMESTER EXAMINATION

1. A major concept that has emerged from studies in ecology is that living things are interrelated with one another and with their

physical environment. In an essay, develop this idea by showing how the concepts of energy, producers, consumers, decomposers, symbiotic relationships, succession, and climax community are relevant to the idea of interrelatedness in ecosystems.

All living things require energy in order to sustain life processes, including growth, movement, metabolism, and reproduction. However, no known organism is able to produce its own energy; instead, all living things obtain their energy either directly or indirectly from the sun. Plants and algae are able to use sunlight directly by converting light energy through the process of photosynthesis into chemical energy that the plant stores in glucose molecules. Because of this ability to "produce" food, plants are called producers. In contrast, animals and other heterotrophs are called consumers because they cannot use the sun's energy directly. Consumers are dependent on producers as their source of life-sustaining energy. Decomposers are consumers that obtain their energy from the chemical energy stored in wastes or in the dead bodies of the organisms they feed on.

Thus, producers, consumers, and decomposers are interrelated in their food relationships. Some of the patterns of energy transfer involve one animal eating or feeding off of another animal, classified as predator-prey or parasite-host relationships. Other types of symbiotic relationships between organisms include competition, commensalism, and mutualism. These three types can, but do not necessarily, involve food relationships. For example, a commensalist relationship between woodpeckers and other birds exists because abandoned woodpecker holes provide nest sites for other species of birds. Or, species of plants in a tropical rain forest might interact by competing for space or sunlight.

Producers, consumers, and decomposers are also interrelated within their physical environment, which includes climate, soil, pollution, and other factors. The physical environment determines which organisms can live in an area and, to a large extent, the geographical distribution of species. Biomes, areas with distinct environmental characteristics, exist because climatic differences enable particular species of plants to survive. For example, many water-loving plants cannot survive in the hot, dry climatic conditions of a desert. Climate also has an effect on animals, particularly in regions that experience a cold winter season. For example, insects die and amphibians and some mammals hibernate during the cold weather.

Just as the environment influences plant and animal life, the opposite is also true. As plants and animals perform life processes, die, and decompose, they change the soil and other environmental conditions in an area. A change in physical conditions can, in turn, cause a significant change in vegetation. The series of changes that take place in an area are known as succession, a dynamic process resulting from the interplay of biological and physical factors in the environment. As one community of plants and animals replaces another, succession eventually results in a climax community of vegetation and associated animals that interact in a balanced ecosystem.

2. Explain how on a molecular level a gene mutation could be responsible for a new phenotype and then describe a possible way that the phenotype could become established in a population. Use an example (real or imagined) in your explanation. Make the following assumptions: the mutation takes place in an organism that reproduces sexually; the one gene under consideration codes for pigment composed of one kind of protein; the original pigment (before mutation) is light-colored; the mutation involves one nitrogen base change, creating a recessive allele; the protein that results from the mutation produces black pigment.

Originally all the moths of a particular species were light colored due to the presence of a light-colored pigment in their wings. On a molecular level the light-colored pigment found in the moth's wing cells were found to be composed of a particular protein. This protein was coded for by a particular gene found on each of two homologous chromosomes. Originally, all the alleles of this gene (in the entire moth population) were identical. In terms of DNA, this means that the sequence of nucleotide bases for this trait was the same in all moths of this species. Each group of three nitrogen bases codes for one amino acid. When the amino acids coded for by the gene were bonded together, the result was a protein that formed light-colored pigment in wing cells.

At some point one moth was exposed to mutagens—chemicals or cosmic rays in the environment—which caused a change in the DNA structure in its sex cells. Suppose, for instance, that one nitrogen base in a nucleotide of DNA was changed from thymine to adenine. This would create a new sequence of bases, which, in turn, could possibly code for a different amino acid. A difference in one amino acid radically changed the protein so that, in effect, black pigment would be produced in place of light-colored pigment. If this mutation occurred on one allele, a moth would be heterozygous but would remain light-colored since the allele for light-colored pigment is dominant. During the process of meiosis, this moth would produce haploid gametes, each of which would contain only one allele for the gene determining wing color. One half of the gametes would have the original allele for light-colored pigment, and the other half would have the mutated allele for black pigment. The black pigment allele would be passed onto some of the next generation, who would be heterozygous. If two of these heterozygotes were to mate, 25 percent of their offspring would have the black phenotype, since they would be homozygous for the recessive allele. In this way, both phenotypes would be seen in the population for the first time.

The proportion of one phenotype to another would be greatly influenced by environmental conditions. For example, suppose that the moths were living in a heavily industrialized area where tree trunks were darkened by soot. Since dark moths would be camouflaged, they would be eaten less often by predators. Thus, more black moths than light moths would survive and reproduce. The black moths

would survive to pass their alleles onto the next generation and in this way, what started out as a mutation could become an established trait in a population.

3. Since organisms do not live forever, an essential characteristic for continuance of species is the ability of individual living things to reproduce. Describe how reproduction occurs on the level of molecules (DNA), cells, and organisms (asexual and sexual), and draw connections between these levels where possible.

On the molecular level, DNA molecules reproduce in a process referred to as replication, which takes place in the nucleus of cells. DNA is a nucleic acid that forms the main component of chromosomes.

The first step in the process of replication is the opening up of the double helix of the DNA molecule, exposing the nitrogen bases of nucleotides on each side of the helix. In the same cell where this is occurring, nucleotides synthesized in the cell bond to the appropriate DNA nucleotides by base pairing. For example, a nucleotide with the base thymine will bond with an adenine nucleotide located on one of the opened strands of the double helix. After the base pairs bond, the sugar and phosphate group of each nucleotide bond to other nucleotides. By the end of this process there are two identical molecules of DNA.

The process of DNA replication is important to the reproduction of cells. If new cells are to be produced they must have the same genetic material (DNA) so that the organism is a unified whole. Thus, before cell division begins, DNA replication takes place during interphase. Following interphase, double-stranded chromosomes, or pairs of chromatids, go through a series of steps called mitosis and eventually the chromatids separate. Cell division continues and the cytoplasm divides. Two daughter cells, genetically identical to the parent cell are the result. Each cell contains the same number of chromosomes as the original cell.

Organisms can reproduce asexually (involving one parent) or sexually (usually involving two parents). In asexual reproduction, a new individual may result from fission (cellular reproduction by mitosis) or from growth of a piece of the parent organism (for example, buds or plant cuttings). Offspring produced through asexual reproduction are genetically identical to their parent.

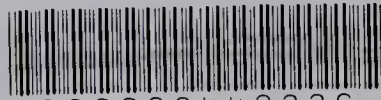
In sexual reproduction, however, both parents contribute one haploid cell to the formation of each new individual. Haploid cells, or gametes, are produced in a process called meiosis. In contrast to mitosis, two cellular divisions take place in meiosis. The result is haploid cells that differentiate into male gametes (sperm) or female gametes (eggs). At fertilization the chromosomes of an egg and sperm unite to form a diploid cell called a zygote. The offspring resulting from sexual reproduction receive DNA from each parent and are each different from either parent and from each other.

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